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THE DAY THE RIVER RAN AWAY: THE IMPACT OF A
CHILDREN'S LITERATURE BOOK AND ACCOMPANYING
CURRICULUM UPON STUDENT PERCEPTIONS
OF THE SALTON SEA

A Project
Presented to the
Faculty of
California State University,
San Bernardino

In Partial Fulfillment
of the Requirements for the Degree
Master of Arts
in
Education:
Environmental Education

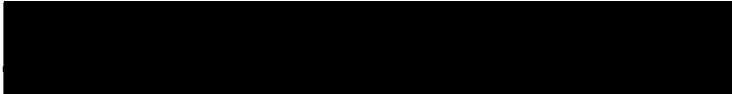
by
Kathryn Ann Schofield
December 2008

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Approved by:


Herbert Brunkhorst, First Reader


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11-25-08
Date

ABSTRACT

Despite its location between the Coachella and Imperial Valleys, the Salton Sea remains unknown to many local residents. However, decisions about the future use of Salton Sea water will have a definite environmental impact upon the health of valley residents and their property values. In order to increase awareness of the Salton Sea among third grade students at a Coachella Valley elementary school, a book about the Salton Sea titled *The Day the River Ran Away* and an accompanying Salton Sea curriculum were developed.

The book and curriculum were taught to 32 students in the author's third grade classroom. Prior to the unit, students' awareness, attitudes, and knowledge about the Salton Sea were assessed through three instruments. Six inquiry-based lessons covered the historical, ecological, and environmental issues associated with the Sea. Following the lessons, student awareness, attitudes, and knowledge about the sea were again assessed. Students showed a 33% to 66% gain in factual knowledge about the Salton Sea. In addition, students increased their awareness and positive attitudes toward the sea. The impact of factual knowledge helped even these young

students develop a sense of personal responsibility for
the Salton Sea.

ACKNOWLEDGMENTS

To Dr. Herbert Brunkhorst, whose encouragement made this project possible.

To Sandra Jones, who got me started and kept me going.

DEDICATION

Dedicate to Steve, whose patience is endless.

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CHAPTER ONE

BACKGROUND

Geological and Historical Background

California's Salton Sea is the largest inland body of water in the state, located 35 miles north of the Mexican border, 60 miles west of the Colorado River, and 90 miles east of San Diego, California (Cohen, Morrison, & Glenn, 1999). The Sea fills an inland basin known as the Salton Trough, also called the Salton Sink (Cohen et al., 1999

The Salton Sea is not the first body of water to occupy the Salton Trough (Cohen et al., 1999; Wardlaw & Valentine, 2005). The geological record (Cohen, 2007; Howard, Stock, Rockwell, Schafer, & Webb, 2007; MacDougal, 1914) indicates that, on at least four different occasions, the Salton Trough had been the site of an inland sea created by the Colorado River.

Over 30 million years ago, the Gulf of California reached as far north as present-day Indio, California (Cohen et al., 1999). According to Cohen (2007), during the Pleistocene Period the Colorado River poured into the Gulf, gradually depositing silt that built a delta. That

delta cut off the upper part of the Gulf and created ancient Lake Cahuilla. As Lake Cahuilla evaporated, it left a flat, salty plane in an oblong shape 80 miles long and 30 miles in width (MacDougal, 1914). This dried out lakebed became the Salton Sink (MacDougal, 1914). The Colorado River periodically cut through the delta, creating a cycle of flood and evaporation that refilled and emptied Lake Cahuilla at least four or five times (Howard et al., 2007).

In 1843, the U.S. Topographical Engineers, under Lt. K. S. Williamson, explored the Salton Sink while looking for a practical railroad route to California (Cohen et al., 1999; Laflin, 1995; MacDougal, 1914). According to Laflin (1995), William R. Blake, the expedition geologist, was the first to read the geological history of the Salton Sink and recognize the marks of an ancient sea. The Cahuilla Indians who inhabited the region informed Blake that their ancestors had once lived near the sea and had come to fish, hunt waterfowl, and other small animals (Laflin, 1995). They said that the sea receded little by little, but once rushed back in a flood (Laflin, 1995). William Blake deduced that the soil of

the Salton Sink would be suitable for crops if water could be supplied (Cohen et al., 1999).

The current Salton Sea dates back to 1905 (Cohen, 2007). According to Laflin (1995), the California Development Company was incorporated on April 21, 1896, by engineer Charles R. Rockwood with the purpose of carrying water into the Salton Sink from the Colorado River. Canadian engineer George Chaffey oversaw the installation of a head gate near Pilot Knob, opposite Yuma, Arizona, designed to divert Colorado River water into a canal that flowed south across the border into Mexico, then turned north back into the U.S. toward the Salton sink (Laflin, 1995). Rockwood and Chaffey formed a development company called the "Imperial Land Company" to attract settlers to the desert region they optimistically called "The Imperial Valley." Laflin (1995) implied that the investors chose the name "Imperial Valley" because they didn't want to scare off prospective settlers by using the word "desert."

By 1901, the California Development Company succeeded in delivering Colorado River water to the Imperial Valley (Cohen et al., 1999). However, the canals soon clogged with silt from the sediment-rich waters of

the Colorado, and the fields of the Imperial Valley began to dry up (Cohen et al, 1999). When dredging didn't solve the problem, the California Development Company cut a new water intake south of the border, not even waiting for official permission from the Mexican government (Cohen et al., 1999). In the winter of 1904-1905 ((Cohen, 2007; Laflin, 1995; MacDougal, 1914), this temporary intake proved to be a disaster. An unusually wet winter in the Colorado River Basin resulted in three powerful floods (Cohen et al., 1999), which tore out the new water intake and undercut the riverbed. By the summer of 1905, the river was discharging 90,000 cubic feet of water per second and a new Salton Sea began to form (Laflin, 1995).

For over 18 months the Colorado raged unchecked, scouring out a deep channel known as the New River (Laflin, 1995). The New River rushed to the lowest point of the Salton Sink, inundating the salt mining facility of the New Liverpool Salt Company, which had been in place since 1884 (Laflin, 1995). By June of 1906, the lake was rising as much as seven inches a day, ultimately covering 400 square miles.

The cross-country route of the Southern Pacific Railroad Company also fell victim to the rising sea, and

40 miles of track had to be relocated to the eastern side of the valley (Laflin, 1995). Mr. E. H. Harriman, President of the Southern Pacific Railroad, appointed Epes Randolph, one of the most respected civil engineers in the United States, to stem the flood (Laflin, 1995). Under Randolph's direction, the railroad built a trestle across the gouged-out water intake and dumped railroad car after railroad car of rocks and fill material into the breach. Finally, the river was contained and returned to its usual course (Laflin, 1995).

At first, evaporation began to shrink the Salton Sea (Cohen, 2007). However, unlike previous occasions when Lake Cahuilla had flooded and then eventually disappeared due to the natural process of evaporation, humans had entered the equation. When the Colorado River was safely returned to its previous course, irrigation canals brought water to the Imperial and Coachella Valleys. Runoff from flooded fields flowed down the Alamo, Whitewater, and New River channels into the Salton Sea, creating a dynamic equilibrium (Cohen, 2007), within the seasonal ebb and flow of irrigation runoff.

The Salton Sea soon became a major waterfowl habitat, especially for migrating birds on the Pacific

Flyway (Cohen, 2007). Cohen, Morrison, and Glenn (1999) stated that the Sea was home to the second-greatest number of United States bird species. More than 380 species of birds have been observed at the Salton Sea (Cohen et al., 1999).

Environmental Concerns

This subsection discusses environmental concerns that impact the many species living at the Salton Sea. It also discusses the potential environmental impact upon human inhabitants of the Coachella and Imperial Valleys if the surface of the Salton Sea is reduced.

According to the Salton Sea Database Program (2008), two-thirds of all bird species in the United States have been observed at the Salton Sea, a number greater than the number of species counted in the Florida Everglades. This fact makes the Salton Sea critical habitat for the continued existence of many endangered species. The Sea provides home for 80% of the American white pelican, 45% of the threatened Yuma clipper rail, and 90% of the continental population of the eared grebe (Salton Sea Database Program, 2008). The Sea supports an estimated 200 million fish (Salton Sea Database Program, 2008).

However, this important habitat is changing. The Salton Sea has been increasing in salinity (Wardlaw & Valentine, 2005). At its creation, the Salton Sea had a salinity of 3.5 parts per thousand (ppt). In 1997, the salinity was 44 ppt (Wardlaw & Valentine, 2005). The Salton Sea now has a salinity that is 25% higher than that of the ocean (Cohen et al., 1999). A study done by Wardlaw and Valentine (2005) showed the presence of concentrated brines in the sediments underlying the Sea. In the north, these brines were dominated by magnesium and sulfate (Wardlaw & Valentine, 2005); in the south, sodium and chloride prevail. Wardlaw and Valentine (2005) postulated that the brines were caused by the gradual dissolution of evaporate deposits. They indicated that an annual increase in salinity of 6% of the current riverine input might be occurring due to dissolution of sediments. However, Tostrud (1997) indicated that the Sea's solubility limit for sulfates and several other salts may have been reached.

Pollution from agricultural runoff has become a major problem for the Salton Sea. Patten, McCaskie, & Unitt (2003) said that the water of the New River, which comes from agricultural runoff and flows into the Salton

Sea, is the most polluted of any waterway in the United States. That status might change somewhat, according to the Salton Sea Authority (2006), with the construction of a waste treatment plant in Mexicali now underway. The Salton Sea Authority (2006) indicated that the levels of human waste products in the New River would significantly decrease after the plant is completed. However, agricultural runoff from the Imperial and Coachella Valleys will continue to carry pollutants into the Salton Sea.

Patten et al. (2003) found that annual inflows to the Sea contained nitrogen, phosphorus, pesticide residues such as DDT, selenium, and other metals (Patten et al., 2003), including arsenic and boron. The waters of the Sea nourish algae and bacteria, and produce an eutrophic condition (Cohen et al., 1999). Eutrophication occurs when water filled with mineral and organic nutrients promote the growth of algae, which in turn reduces the oxygen available in the water, and causes the extinction of other species. This anaerobic condition has been responsible for the massive fish die-offs for which the Sea has been notorious, as well as the spread of avian diseases (Cohen et al.).

One of the most dangerous pollutants in the Salton Sea is selenium (Cohen et al., 1999). According to the U.S. Department of Health and Human Services (2003) selenium is a naturally occurring trace mineral that, in very small amounts, is needed for human health. Processed selenium is used in the manufacture of many products, including electronics, plastics, paint, and pesticides. Some compounds of selenium dissolve in water, while other forms of selenium settle out of solution and accumulate at the bottom of large bodies of water. Much of the selenium in the Salton Sea comes from agricultural runoff and is concentrated within the seabed sediments, placed there by the metabolic activity of bacteria (Cohen et al., 1999).

The U.S. Department of Health and Human Services (2008) listed selenium as a hazardous substance because exposure to high concentrations of selenium causes a disease called selenosis. Symptoms of selenosis include hair loss, numbness, and other neurological abnormalities. Prolonged exposure to selenium dust causes respiratory tract diseases (Department of Health, 2003). Selenium is known to cause deformities, reproductive failure, and death among water birds (Cohen et al., 1999;

Oglesby, 2005). Selenium travels up the food chain and accumulated in animal tissues (Cohen et al., 1999). The California Health Advisory Board warned that people should not eat more than four ounces of fish caught in the Salton Sea within any two-week period (Cohen et al., 1999; Oglesby, 2005).

In 2003, an agreement signed by multiple water agencies in Southern California transferred water from Imperial Valley farmers to San Diego (Cohen, 2007). Because of these agreements, the water flowing into the Salton Sea will decrease by more than 40 percent in the next 20 years (Cohen, 2007). The surface of the lake will shrink by a third, drying 350 square kilometers of lakebed, sending fine particles of selenium and arsenic-laced dust blowing through the Coachella and Imperial Valleys (Cohen, 2007). Cohen & Hyun (2006) estimated that this fine wind-blown dust will increase over 33% more than its current amount when the surface of the lake shrinks. Both children and the many retirees who live in the Coachella and Imperial Valleys are particularly vulnerable to reduced air quality (Cohen & Hyun, 2006). The rate of hospitalization for childhood asthma in the Imperial Valley is already the highest in

California (Cohen & Hyun, 2006), and will only get worse if the seabed is exposed.

One proposal to save the Sea made by the Salton Sea Authority (2006) is to split the Sea into a northern freshwater lake and a southern brine pond. Unless some agreement is reached to save the Sea, Cohen (2007) warned of ecological disaster as soon as 2018 as the ecosystem collapses. With reduced volumes of water in the sea, high salinity and low levels of dissolved oxygen will cause fish to die. Most birds will abandon the Sea as the availability of food declines (Cohen, 2007). Human health will be at-risk as particulates of selenium and arsenic-laden dust blow through the region.

Introduction to the Project

Against this background of historic human-made disaster and potential ecological disaster, this project is focused on an author-created children's literature book about the Salton Sea called *The Day the River Ran Away*. An accompanying Salton Sea curriculum has been developed for third grade students in the Coachella Valley, which is located in close proximity to the Salton Sea. The project is significant because the ecological

future of the Salton Sea will directly impact the health, property values, and lifestyle of residents of the Imperial and Coachella Valleys (Cohen, 2007).

A review of the literature found no comprehensive Salton Sea curriculum for elementary students, the decision-making residents of the future. The intent of this project is to build ecological awareness and knowledge, so that as Coachella Valley students mature, they will have the knowledge, attitudes, and skills to participate in future decisions regarding the Salton Sea.

The curriculum is designed to provide a place-based educational approach (Sobel, 2005; Lieberman & Hoody, 1998) to the Salton Sea, using integrated-interdisciplinary instruction in language arts, science, and social studies. It is based on California State Department of Education (1998) content standards for third grade. The specific standards are listed in appendix .

Information about this project is organized in five chapters. The current chapter, the Introduction, discusses the geological, historical, and ecological history of the Salton Sea. This background information provided the foundation for the author-created book, *The*

Day the River Ran Away. It also served as the basis for the accompanying curriculum, and pointed the way to the knowledge, attitudes, and skills that this project aims to help students achieve. Chapter Two reviews the literature about environmental education, especially as expressed in place-based education, and the use of children's literature to teach environmental concepts and develop critical thinking skills. These concepts provide the educational underpinnings of the project curriculum. Chapter Three presents the design of the project. Chapter Four discusses the results of the project. Finally, Chapter Five examines the implications of the project as well as some conclusions. The Appendix includes the specific Salton Sea curriculum developed for the project, as well as the data that supports the impact of the author-created book. It also contains the California State Department of Education content standards for third grade upon which the curriculum is based. References for the project are found at the end.

Because only 32 students participated in the project, the results cannot be generalized. Analysis of student perceptions and attitudes was limited to the Salton Sea Attitude and Awareness Survey, and to

observations made by the author of student comments and behaviors. Because this was one intervention, limited to one instrument at one point in time, the reliability of the data is limited.

CHAPTER TWO

LITERATURE REVIEW

Place-based Environmental Education

Stapp et al. (1969) declared that "environmental education is aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems and motivated to work toward their solution" (pp. 30-31). This subsection explores what the literature says about implementing curriculum that will promote the development of the kind of informed, aware, and articulate citizenry that Stapp et al. discussed.

One of the seminal documents of environmental education is the Tbilisi Declaration, which was the result of a UNESCO-sponsored conference held in 1977 at Tbilisi, Georgia, in the USSR. Hungerford, Peyton, & Wilke (1980) listed four levels of goals for environmental education that were based on the Tbilisi Declaration of 1977. These levels were the ecological foundations level, the conceptual awareness level, the investigation and evaluation level, and the action skills level. According to Cullen (2005), these four levels of

goals underlie the conceptual framework for most environmental education curriculum. These four goals provided the conceptual framework for the curriculum developed in this project.

Wells and Zeece (2007) discussed how the United States was falling behind in science education, especially in instruction about the environment at a time when difficult environmental choices faced the nation. When children did receive information about the environment, it was usually disconnected from the limited understanding young children have about their world. Wells and Zeece (2007) advocated place-based learning, grounded in the locales in which children live and learn, as a way to help young children connect to the environment.

Hungerford and Volk (1991) declared that for environmental education curriculum to be effective, it must be based within the context of the local school, the community in which students live, and the region in which the community functions. Lieberman and Hoody (1998) advocated using the local environment as an integrating context to teach students. The local environment becomes a framework in which students learn about the natural

ecosystems and socioeconomic conditions in their community (Lieberman & Hoody, 1998). Under such place-based curricula, students learn both about the natural environment and the human-made environment that surrounds them (Sobel, 2004).

Leiberman (1997) developed a model for using Environment as an Integrating Context for Learning (EIC). The EIC model consists of eight strategies to use environment as an integrating context to improve student learning. The first strategy is to use local natural and community surroundings as context. The area in which students live becomes the setting for standards-based instruction. Educators draw upon the normal interest and connection that children have with both their natural and human-made surroundings to motivate learning. The second EIC strategy is to use natural and social systems within the community. Students become knowledgeable about the complex systems of the natural world, as well as the social and cultural environment in which they live. Students examine the interrelationships of natural and physical phenomena. The third EIC strategy is to provide community-based investigations that give learners opportunities to apply knowledge and skills acquired in

the classroom to real world settings. The fourth strategy in the EIC model allows educators to provide integrated, interdisciplinary instruction. Curriculum crosses traditional academic boundaries and encourages students to explore the all aspects of the subject they are investigating. The fifth strategy in EIC learning is to provide age-appropriate opportunities for service activities that require students to reflect upon their learning and contribute service back to their community. The sixth EIC strategy is collaborative learning. Community members, educators, and students are involved in planning and delivering instruction. Students develop social skills through opportunities to cooperate with others. The seventh EIC strategy is to take a learner-centered approach. Educators incorporate multiple intelligence theory in developing curriculum. They consider students' cultural background and language proficiency in delivering instruction. Students construct their own understanding as they define and carry out specific learning goals and objectives as appropriate to their age and maturity level. Finally, the eighth EIC strategy is for educators to facilitate both cooperative and independent learning.

In designing the curriculum to accompany the book used for this project, the author has taken into consideration the EIC model. The author has attempted to adapt the model as far as possible to the abilities of third-grade students. She has also taken into consideration the impact of No-Child-Left-Behind legislation upon educators' flexibility within the classroom, and tried to design the curriculum in such a way that it could be modified to different situations.

Using Children's Literature in Environmental Education

This subsection of the literature review explores the impact of children's literature upon students' understanding of environmental concepts. Dresang (2003) discovered that elementary school-aged children were capable of understanding environmental issues, because they sought connections and desired to explore the world around them. Wells and Zeece (2007) proposed that literature could be used to introduce children to place-based environmental concepts. By invoking a context that was familiar to children, literature helped students to connect to the real world, and learn about the relationships between ecosystems and the cultures in

which children operate. Butzow & Butzow (1999) proposed that stories present facts and concepts in ways that children can best understand. Students can generalize about information presented in stories that otherwise are too abstract for their developmental level (Butzow & Butzow, 1999).

Wells and Zeece (2007) addressed the issue of developmental readiness in environmental education, saying that before age eight, children cannot distinguish fantasy and reality. For example, young children apply anthropomorphic characteristics to animals. Wells and Zeece (2007) indicated that for this age group, books could be selected that anthropomorphize animal characters, as long as they present ecological information accurately in illustrations and text.

Wells and Zeece (2007) suggested that children should be taught to appreciate the natural world, rather than be exposed to books that present more negative aspects of ecological destruction. Young children should develop a sense of wonder about the world before they are asked to save it. Books should be selected that give children feelings of hopefulness and empowerment to make a difference in the environment (Wells & Zeece, 2007).

For Meyer (2002), a way to expose children to environmental issues was through children's literature. Meyer (2002) advocated using children's literature to help students develop a sense of wonder and joy about the natural world. Meyer also stressed that children's literature should not sacrifice scientific accuracy for readability and excitement. The natural curiosity children had towards their surroundings provided the perfect opportunity for children to read, write, and make sense of their world (Meyer, 2002). It is for this reason that the author has written a children's book about the Salton Sea.

Using Children's Literature to Promote Critical Thinking about Environmental Concepts

This subsection discusses how the use of children's literature in environmental education can promote the development of critical thinking skills in children. The target population of this project is third-grade children, who are usually ages 8 and 9. According to Hungerford and Volk (1991), critical thinking skills were developmental. Hungerford and Volk (1991) noted that children ages 6-10 can explore environmental issues of local significance when properly directed by their

teachers. Hungerford and Volk (1991) stated that even learners as young as ages six to ten can develop environmental concepts, explore issues in a limited fashion, and attempt to make group decisions.

Christenson (2004) described a study of teachers from the Educators Collaborative Change Professional Development Site in which elementary school teachers used children's literature to foster discussion of environmental issues. When they did so, they thought children connected to and remembered the information much better than when subjects were taught without inclusion of literature (Christensen, 2004). The students began using environmental terms in their oral and written vocabulary. In addition, teachers felt that students learned to identify diverse viewpoints and think more critically about issues. The teachers' perceptions were that students' ability to distinguish fact and opinion had improved (Christensen, 2004).

Wolk (2003) declared that critical literacy is about how people see and interact with the world. A critically literate person has the skills and desire to evaluate society and the world. Wolk (2003) indicated that critical literacy enables one to evaluate complex issues

such as gender, race, culture, class, politics, media, and the environment.

According to Wolk (2003) critical literacy goes beyond critical ways of evaluating information. It encourages children to develop their creative imaginations to envision new ways of living. Wolk proposed that teaching for critical literacy is an anti-racist and anti-oppressive venture, with the purpose of helping children to think and make daily decisions that will help make a better world. Wolk suggested that traditional textbooks were written from the perspective of history's winners, and that silenced voices from native peoples, the poor, the working class, minority cultures, and the ecosystems of the planet could be heard through the inclusion of literature presenting diverse points-of-view.

Summary

Hungerford, Peyton & Wilke's (1980) four levels of goals for environmental education provided the framework for the project. *The Day the River Ran Away* curriculum was designed to increase knowledge of ecological foundations and conceptual awareness. Activities in the

unit helped students investigate and evaluate issues surrounding the Salton Sea. Although action skills were limited at the third grade level, the author hoped to foster students' sense of connection to and responsibility for the Salton Sea.

As far as possible strategies from Lieberman's (1997) Environment as an Integrating Context for Learning (EIC) model were incorporated in curriculum design. The context used was the Salton Sea. The surrounding desert environment was familiar to the students, providing a touchstone to teach ecological concepts and the interrelationships of natural and physical phenomena. The curriculum provided integrated, interdisciplinary instruction, starting with the literature book and moving to ecological concepts, and well as the historical and social aspects of the Salton Sea. Activities in the curriculum were collaborative and age-appropriate. The approach was learner-centered, and the intent was to help students construct knowledge about the Salton Sea.

As Butzow & Butzow (1999) proposed, stories provide a context through which children can understand complex facts and concepts. *The Day the River Ran Away* provided a framework through which children can learn that humans

have an impact upon the natural world, and that decisions made today affect what the world will be like tomorrow.

Wolk (2003) spoke of the anti-racist and anti-oppressive results of teaching for critical literacy. In writing *The Day the River Ran Away* (Appendix A), the author tried to present the point-of-view of people and creatures impacted by the creation of the Salton Sea. For example, Gloria Torres and Fig Tree John represent the silenced voices of the native peoples whose lives were disrupted when the Colorado flooded. The section on the hawk and the later section about the osprey represent the ecosystems that have been and will be disrupted by changes within the Salton Sink.

In selecting activities for inclusion in the unit, the author tried to create an environment where students could first participate in an activity, and then form conclusions about what the activity meant. For example, a game was developed to show what happened to fish in the Salton Sea as the parts per thousand (ppt) of salt increased. In the game, fresh water fish are replaced by salt water fish. After participating in the game, students then were encouraged to think what would happen if the ppt of salt in the sea increased beyond the limits

in which fish could survive. They then discussed what would happen to the birds if the fish they need to survive disappeared. The point was to help students think critically about the impact of human decisions upon the sea.

Although this project does not assume that children in third grade will be conducting the kind of higher level analysis of which Wolk spoke, the author is mindful of Hungerford and Volk's (1991) call for an articulated curriculum across grade levels that allows for critical thinking opportunities and issue analysis from an early age. Hungerford and Volk said that teachers often underestimate their students' abilities to comprehend and learn. This project allows opportunities for students to stretch and learn as much as they can about the Salton Sea, because it is an issue that they, as residents of the Coachella Valley, will have to deal with as they mature.

CHAPTER THREE
PROJECT DESIGN

Introduction

Participants in the study were 32 third grade students in the researcher's classroom at James Madison Elementary School in Indio, California. The City of Indio is located at the southern end of the Coachella Valley, in close proximity to the Salton Sea, which is the subject of the study. Residents of Indio find employment in agriculture, construction, retail stores, and in the tourism industry associated with the Coachella Valley.

The 32 subject students at James Madison Elementary School were involved in the study by virtue of their class membership, and through permission obtained from both students and their parents/guardians. Prior to implementation of the project, a written Parent's Informed Consent Form (Appendix B) was inserted in the back-to-school packet that went to each parent on the first day of school. The Child's Assent to Participate in Study form (Appendix C) was also in the same packet. The forms were available in both English and Spanish. Forms were returned the second day of school with other

information required by the school. The project was also explained at the back-to-school night that immediately preceded implementation of the project. Of the 32 students who began the school year in the instructor's classroom, 100% of the Informed Consent forms were signed and returned. Data from three students who joined the classroom after the permission slips were distributed were not included in the study.

James Madison Elementary School is part of the Desert Sands Unified School District in California's Coachella Valley. The school enrolls students from kindergarten through fifth grade, with a student population of 740 in the 2007-2008 school year. The school is a Title I school. The ethnic breakdown of the school population is as follows: Hispanics -83%; White, not Hispanic - 9%; Multiple or No Response - 6%; African American, Not Hispanic - 1%, and Filipino, American Indian or Alaskan Native and Asian - less than 1%. In 2007-2008, 40% of the students were English Language Learners, with 90% of the second-language students speaking Spanish as their first language. In 2007-2008, 64% of the student body qualified for free or

reduced-priced lunch. Data for the 2008-2009 year were not available at the time of this writing.

In the researcher's third grade classroom, 14 of the subject students were male, and 18 were female. English was the primary language for 12 of the students, or 37.5%. Spanish was the primary language for the remaining 20 students, or 62.5% of the class. The curriculum was designed with the needs of second language learners in mind. Specifically, the use of art, games, photographs, an animated web site, PowerPoint slide presentations, artifacts, and inquiry-based lesson plans were included to reinforce verbal information. None of the students in the classroom have been formally identified as Gifted and Talented (GATE); however, the variety of approaches used in the lesson plans addressed many different learning styles.

Hypothesis

The hypothesis of the study was that student knowledge and awareness of the Salton Sea and its associated historical and environmental issues can be enhanced through the use of an author-created literature book and related curriculum about the Salton Sea. The

objective was to develop a place-based curriculum to make local students more knowledgeable about the Salton Sea. For this purpose, an author-created children's book called *The Day the River Ran Away* (Appendix A) was written, and an accompanying curriculum was built upon concepts presented in the book. The book was used or referred to directly in five out of six lessons. All lessons met California State content standards for third grade, as well as the California Department of Environmental Protection goals for environmental education (Appendix D). The curriculum about the Salton Sea was included in the regular course of social studies and science instruction. There were three existing social studies units in which Salton Sea instruction was inserted: California's geological features, including landforms and water bodies; California deserts; California's early inhabitants, including native peoples, early explorers, and settlers of the region; and California's communities. Two science content units in which the Salton Sea lessons were inserted were matter and energy (water cycle), and adaptations and habitats.

Instrumentation

Quantitative data was collected through written pre- and post-tests designed to assess student knowledge and awareness of the Salton Sea. Two written assessments were given at the beginning of the unit and again at the end. The first, a 15 question Salton Sea Attitudes and Awareness Survey (Appendix E), was designed to assess student awareness and attitudes toward the Salton Sea. The survey was read aloud by the teacher. Students responded by circling a happy face that had a smile for "Agree," a straight line for "I don't know," and a frown for "Disagree." The second written assessment (Appendix F) was a 15 question multiple-choice test assessing factual knowledge about the Salton Sea. In addition to the written assessments, prior to the unit students were given a piece of paper with the directions to "Draw everything you know about the Salton Sea." At the end of the unit, they were given another copy with the same instructions (Appendix G). The researcher counted items that were Salton Sea appropriate in both the first and second sets of drawings. Then the frequency of items in each set was compared.

Qualitative data was gathered anecdotally through observation of increased use of related vocabulary in oral and written language, through student comments that reflect greater understanding of concepts presented, and through a comparison of the frequency of Salton Sea concepts in student artwork created before and after the curriculum was presented.

Confidentiality of Data

Confidentiality of data was ensured in several ways. Participants were randomly assigned a number, and that number was used in all discussion of individual responses. Student responses and artwork were kept confidential in files at the researcher's home. In addition, students were not assigned a report card grade for the portion of curriculum inserted because of the study. This research presented no greater than minimal risks as a result of participation in the study.

Peer Review

Because of the young ages of the children involved, the curriculum was peer-reviewed by the author's fellow third-grade teachers to ensure that information was presented in a positive, non-threatening manner that was

age appropriate. Comments from the author's peers were useful in revising the text of *The Day the River Ran Away* to make it clearer. One comment, for example, resulted in the addition of the section showing Gloria Torres leaving her home. Another resulted in extensive revision of the part about Charles Rockwood. The teachers asked if they could use the curriculum in their classrooms.

Intended Outcomes

The curriculum's designer hoped to achieve such beneficial outcomes as increased student awareness and knowledge about the ecological and environmental issues facing the Salton Sea. It was hoped that students would develop a sense of connection to and responsibility for the Sea. In future years, as citizens living near the Salton Sea, students may be called upon to make decisions about the Sea that could have an enormous impact on the health, lifestyle, and property values of the Coachella and Imperial Valleys. This unit was intended to provide a base from which students could develop further knowledge and decision-making skills.

Lessons

The unit included the author-developed children's book, games, PowerPoint presentations, and demonstrations that were embedded in six lessons. The lessons were organized by content, rather than the time required to teach each one. In actuality, it took nine 45 minute sessions to teach the unit, including two days for pre- and post-assessments. Prior to the first lesson, a 45 minute pre-assessment of student knowledge and attitudes about the Salton Sea was conducted. Then the first lesson (Appendix H) was used to build background knowledge about the Salton Sea, and to read aloud the book *The Day the River Ran Away*. Following the read aloud, the questions presented in the lesson plan were asked to help the students discuss the book. The lesson took 45 minutes.

Lesson Two (Appendix I) helped the students see that in the process of changing from a desert to an aquatic environment, both the physical features of the environment as well as the bird population changed. The students participated in a game that simulated the migration of birds on the Pacific Flyway, and the impact that changes in the environment had upon the bird populations. In this case, the Salton Sea created new

riparian and aquatic habitat, bringing new species of birds into the desert. This lesson took two-45 minute sessions, which included extension activities.

In Lesson Three (Appendix J) students created a salt water pond in a small metal pan to simulate the Salton Sea environment. Over the course of the unit, the water was allowed to dry out, leaving behind salt crystals. Students also learned about the water cycle and the formation of rain shadow deserts such as the Salton Sink and Coachella Valley. This lesson was spread over a week. During the first 45 minute lesson students created the "Salton Sea" pans, and learned about the water cycle. Then over the course of a week students observed the evaporation process in the pans and the formation of salt crystals.

Lesson Four (Appendix K) demonstrated the concept of parts per thousand (ppt) in water. The students played a game that simulated the increasing levels of salt in the Salton Sea. The game showed the switch from freshwater fish to salt water species as the ppt of salt increased from 4 ppt in 1907 to 43 ppt in 1936. The fish cards in the game represented species that inhabited the sea at different points in time. This lesson took 45 minutes.

Lesson Five (Appendix L) focused on the peoples of the Salton Sea, from the early ancestral Cahuilla through explorers, miners, homesteaders, soldiers, and on to the current inhabitants. The students participated in developing a timeline of the Salton Sea. This was a 45 minute lesson.

Lesson Six (Appendix M) was a review lesson that took 45 minutes. The students reread *The Day the River Ran Away*. They then viewed two PowerPoint presentations: *The Salton Sea Yesterday* (Appendix N) and *The Salton Sea Today* (Appendix O.) The pictures and scripts of the presentations both reviewed previous information and showed additional pictures to reinforce the unit.

Following the final lesson, the original three pre-assessments were administered once more, and the data from the pre-tests was compared with data from the post-tests.

CHAPTER FOUR

DATA ANALYSIS

Salton Sea Awareness and Attitude Survey

The Salton Sea Awareness and Attitude Survey (Appendix E) was administered twice. The first administration took place prior to any classroom instruction about the Salton Sea. The second administration followed classroom instruction, and was used as a post-test. Students were given 15 statements about the Salton Sea. Beneath each statement were three smiley faces: one with a smile and the word "Agree;" one with the mouth in a straight line and the words, "I don't know;" and one with a frown and the word, "Disagree." The students circled the face that most closely matched their feelings about the statement. The teacher read the questions aloud in both the pre- and post-assessments, and allowed about one minute per question for students to mark their answers. Thirty-two students took both the pre- and post-Salton Sea Attitude and Awareness questionnaires. The data is summarized in the Attitude Survey Summary (Table 1).

Table 1. Salton Sea Awareness and Attitude Survey Results

Salton Sea Attitude Survey									
32 respondents	Pre-	Post-		Pre- I	Post- I		Pre-	Post-	
QUESTION	Agree	Agree	Change	don't know	don't know	Change	Disagree	Disagree	Change
1. I have heard of the Salton Sea.	24	31	7 +	1	0	1 -	7	0	7 -
2. The Salton Sea is near my home.	1	3	2 +	7	8	1 +	25	17	8 -
3. Sometimes the Salton Sea smells bad.	11	23	12+	20	6	14-	1	3	2 +
4. I would like to visit the Salton Sea.	30	25	5-	1	2	1 +	1	5	4+
5. The Salton Sea is important because many birds live there.	5	18	13+	19	6	13 -	8	8	0
6. The Salton Sea is important because many fish live there.	10	20	10+	16	9	7-	6	3	3-
7. The Salton Sea can be a fun place to visit.	23	21	2-	7	11	4+	2	0	2 -
8. I think the Salton Sea is polluted.	6	17	11+	21	11	10 -	5	4	1 -
9. The Salton Sea is beautiful.	18	24	6+	10	7	3 -	4	1	3 -
10. The Salton Sea is important to me.	10	18	8+	13	9	4 -	9	5	4 -
11. The Salton Sea is ugly.	7	2	5 -	15	10	5 -	10	16	6 +
12. It is dangerous to eat fish from the Salton Sea.	11	20	9 +	14	5	9 -	7	7	0
13. People should take care of the Salton Sea.	22	27	5+	9	5	4-	1	0	1 -
14. The Salton Sea has always been there.	13	11	2 -	18	10	8 -	1	11	10+
15. The Salton Sea may someday dry up.	6	8	2 +	14	14	0	12	10	2 -

The first question, "I have heard of the Salton Sea," was designed to assess student's awareness that the Salton Sea exists. In the pre-test, 75% of students marked "Agree," indicating that they had heard of the Salton Sea, 3% marked "I don't know," and 22% marked "Disagree," indicating they had never heard of the Salton Sea. After participating in the unit, 97% marked "Agree," 3% marked "I don't know," and 0% marked "Disagree." In terms of raising awareness that there was such a thing as the Salton Sea, the unit was very effective.

The second question, "The Salton Sea is near my home," was designed to see whether students were aware that the Salton Sea is near Indio, where the project took place. In the pre-assessment, 3% of students agreed, 22% did not know, and 78% disagreed. Following the unit, 9% of students agreed, 25% did not know, and 53% disagreed. The number of students who did not realize that Indio is near the Salton Sea decreased. The number of students who understood that Indio is near the Salton Sea did not greatly increase. However, most students of this age do not comprehend distance with great accuracy.

Further analysis of the question centers on the word "near." The instructor's definition of "near" may be

different from that of a third-grader. For example, in conversation to elicit the third-grade meaning of near, one student told the author, "The school is near my house because I can walk there. The supermarket (3 blocks from school) is not near my house because we have to go there in the car." To eliminate confusion, question number two will be rewritten to say, "The Salton Sea is less than a one-hour drive by car."

The third question, "Sometimes the Salton Sea smells bad," and the eleventh question, "I think the Salton Sea is ugly," attempted to assess student's negative attitudes toward the Salton Sea. Sometimes the air in Indio has an unpleasant odor associated with the Salton Sea algae blooms and fish die offs. The author felt that since this condition is one of the issues surrounding the Salton Sea, students should be aware of it. In pre-assessment responses to question three, 34% of students agreed that sometimes the air smells bad, 63% did not know, and 3% disagreed. Following the unit, 72% agreed, 19% did not know, and 9% disagreed. Although students' perceptions changed to a more negative view about the air quality of the Salton Sea, the change

reflected the reality of the situation, i.e. an increase in awareness.

On the other hand, in response to question 11, "I think the Salton Sea is ugly," 22% of students agreed in the pre-assessment, 47% did not know, and 31% disagreed. In the post-assessment, only 6% agreed that the Salton Sea was ugly, 31% did not know, and 50% disagreed, showing a 19% increase in positive perceptions of the beauty of the Salton Sea. This finding was reinforced by question 12, "The Salton Sea is beautiful." In the first questionnaire, 56% answered "Agree," 31% answered "I don't know," and 13% said, "Disagree." In the second questionnaire, 75% answered, "Agree," 22% stated "I don't know," and 3% circled "Disagree." Apparently, negative thoughts about the air quality of the Salton Sea did not impact students' perceptions about its visual beauty.

Questions eight and nine were designed to assess students' awareness of the Salton Sea as a major habitat. Question eight, "The Salton Sea is important because many birds live there," tested students' knowledge of the Salton Sea as an important stop for birds on the Pacific Flyway. In the pre-assessment, 16% of students agreed, 59% did not know, and 25% disagreed. Following

instruction, 56% of the students agreed, 19% did not know, and 25% disagreed. Although the number who disagreed showed no change, the number of students who recognized that the Salton Sea is an important bird habitat jumped by 40%.

Question six, "The Salton Sea is important because many fish live there," assessed students' knowledge of the Salton Sea as a fish habitat. In first responses to the questionnaire, 31% of students agreed, 50% did not know, and 19% disagreed. After participating in the unit, 63% of students agreed, 28% did not know, and 9% disagreed. Students' knowledge that the Salton Sea is an important bird habitat showed a 43% increase.

Two questions, numbers eight and 12, assessed students' attitudes about human impact upon the Salton Sea. Item eight stated, "The Salton Sea is polluted." In response to the first survey, 19% agreed that the Sea is polluted, 65% did not know, and 16% disagreed. In the second survey, 53% agreed, 34% didn't know, and 13% disagreed. In response to item 12, "It is dangerous to eat fish from the Salton Sea," 34% responded, "Agree," 44% answered, "I don't know," and 22% circled "Disagree." After the Salton Sea unit, 62% agreed, 16% didn't know,

and 22% disagreed that eating fish from the Salton Sea can be dangerous. So, the number of students who were aware of pollution in the Salton Sea increased as a result of participation in the unit.

Two items assessed student awareness that human action created the Salton Sea and may cause it to dry up. Item 14 said, "The Salton Sea has always been there." In answer to the pre-survey, 41% agreed, 56% did not know, and 3% disagreed. After participating in the Salton Sea unit, 34% agreed, 31% didn't know, and 34% disagreed, a 31% increase in the number of students who knew the Salton Sea was not always there.

Question 15 stated, "The Salton Sea may someday dry up." In the pre-assessment, 19% agreed, 44% didn't know, and 37% disagreed. In the post-assessment, 25% agreed, 44% didn't know, and 31% disagreed that the Salton Sea may someday dry up.

The last set of questions assessed students' personal sense of connection to the Salton Sea. Questions 4 and 7 examined students' interest in personally visiting the Salton Sea. Item 4 indicated, "I would like to visit the Salton Sea." In the pre-survey, 94% of students agreed, 3% didn't know, and 3% disagreed. In the

post-survey, 78% agreed, 6% didn't know, and 16% disagreed. Question 7 said, "The Salton Sea can be a fun place to visit." In the pre-assessment, 72% agreed, 22% didn't know, and 6% disagreed. In the post-assessment, 66% agreed, 34% didn't know, and 0% disagreed.

Ironically, after participating in the Salton Sea Unit, students' desire to personally visit the Salton Sea decreased slightly. The students reacted strongly to pictures of the fish die-off. It can be postulated that increased awareness of pollution caused a negative reaction.

Finally, items 10 and 13 assessed students' sense of personal responsibility about the Salton Sea. Item 10 said, "The Salton Sea is important to me." In the pre-survey, 31% of students agreed, 41% didn't know, and 28% disagreed. In the post-survey, 56% agreed, 28% didn't know, and 16% disagreed. The increase of students who agreed that the Salton Sea was important to them was 26%.

Item 13 stated, "People should take care of the Salton Sea." In the pre-assessment, 69% of students agreed, 28% didn't know, and 3% disagreed. After the unit, 84% agreed, 16% didn't know, and 0% disagreed, an

increase of 15% of students who felt people should take care of the Salton Sea.

Interesting, although the number of students who personally wanted to visit the Salton Sea decreased slightly, the number of students who felt the sea was important to them increased, as did the number of students who felt people should take care of the Salton Sea. The implication is that overall the unit increased students' awareness of the Salton Sea and their sense of personal responsibility for it.

Salton Sea Knowledge Test

The Salton Sea Knowledge Test (Appendix F) was designed to assess student's understanding of basic facts about the Salton Sea. The 15 multiple choice questions were read aloud to 32 students prior to the Salton Sea Unit, and again after completion of the unit. Students circled the letter of their response choice. After initial administration of the test, question item #2 was eliminated because of two possible correct answers. The data analysis for the test was based on the 14 remaining questions, and is summarized in the Salton Sea Knowledge Test Analysis (Table 2).

Table 2. Salton Sea Knowledge Test Analysis

Salton Sea Knowledge Test Analysis				
	Question (includes correct answer)	Pretest	Posttest	Change
1	The Salton Sea was created when the Colorado River broke through the headgate of a canal and rushed into the Salton Sink.	63%	97%	34% +
2	Question 2 was disallowed because of confusing wording.			
3	The Salton Sea is in a desert because it is in the "rain shadow" of the mountains.	25%	47%	22% +
4	The Salton Sea took almost two years to form.	75%	53%	22% -
5	The Salton Sea is an important stop on the Pacific Flyway for birds.	31%	63%	32% +
6	The Salton Sea is critical habitat for over 200 species of birds.	50%	78%	28% +
7	Water now comes into the Salton Sea mostly from agricultural runoff from surrounding farms.	3%	69%	66% +
8	You might find lizards, snakes, and red-tailed hawks in the desert around the Salton Sea.	71%	100%	29%+
9	The Salton Sea may get smaller by the year 2013 because water now going into the Salton Sea will be sent to San Diego.	50%	78%	28% +
10	Two of the most polluted rivers in the United States are the Alamo and New Rivers.	38%	50%	12% +
11	Choose which body of water is saltiest (Salton Sea.)	66%	97%	31% +
12	The beaches of the Salton Sea are made of tufa, a kind of salt.	41%	94%	53% +
13	The first fish in the Salton Sea were freshwater fish such as rainbow trout.	34%	66%	32% +
14	The kind of fish that can live in the Salton Sea now are salt water fish such as tilapia and corvina.	50%	78%	28% +
15	The Salton Sea is near the cities of Indio, Mecca, Thermal, and Brawley.	25%	75%	50% +

Of the 14 questions analyzed, only one had a negative outcome. When question 4, "The Salton Sea took almost two years to form," was first presented, 75% of students choose the correct answer. However, in the post-test, only 53% of students responded correctly, a 22% decrease. The author is not certain why the unit confused the students in this area. However, certain portions of the lessons talked about the ancestral Cahuilla who fished Lake Cahuilla over 10,000 years ago, and of the small shells which can still be found on the valley floor. The PowerPoint presentations showed pictures of the marks left by the ancient shorelines on the mountains surrounding the Salton Sink. It may be that some students were confused by the various reincarnations of lakes in the Salton Sink. The issue will be clarified for future use in the Salton Sea Unit.

On all of the remaining 13 questions, students showed a positive increase in correct responses from the pretest to the posttest. The increase ranged from 12% to 66%, with an average increase of 33%. It is apparent that participation in the Salton Sea Unit helped students learn factual information about the Sea that they had not known before.

Salton Sea Picture Analysis

In addition to the formal Salton Sea Attitude Assessment Survey and the Salton Sea Knowledge Test, students were asked to draw what they knew about the Salton Sea both prior to participating in the unit and following it (Appendix G). Student drawings were analyzed for the presence of items appropriate to the Salton Sea, and for items that did not belong at the Salton Sea (Table 3). The students labeled some items. If the instructor was unsure what the picture represented, she asked the student for clarification. Especially in the first set of drawings, some items appeared that didn't fit in the context of the Salton Sea. For example, pictures of sharks, surfboards, whales, jellyfish, and starfish appeared. These items would be expected in a typical child's drawing of a "sea." In all, 37 inappropriate items were drawn in the pre-assessment.

After instruction, 16 inappropriate items were drawn, a net change of -21, showing increased awareness that that the Salton Sea was not a typical ocean environment. In the first set of drawings, 101 appropriate items appeared that were related to the Salton Sea. After completion of the unit, 239 items

Table 3. Analysis of Salton Sea Drawings

Items Appropriate to the Salton Sea	Pre-Drawings	Post-Drawings	Change
tufa formations	0	7	7+
water	29	34	5+
flying birds	13	15	2+
sun	6	26	20+
boat	3	15	12+
people	2	10	8+
salt works smokestack	0	5	5+
sand	7	19	12+
rainbow trout	0	7	7+
large fish	11	18	7+
sucker mouth fish	0	4	4+
small fish	17	19	2+
shorebird	0	9	9+
underwater buildings	0	2	2+
swimmer	0	4	4+
fisherman	2	6	4+
children playing	1	3	2+
mountains	0	0	0
pier	0	3	3+
beach club ruins	0	2	2+
marina walls	0	3	3+
shells	1	3	2+
rocks	1	3	2+
beach umbrella	1	2	1+
shade structure	0	1	1+
hawk	0	1	1+
posts in marina	0	4	4+
palm tree/fig tree	2	3	1+
waterskier	1	2	1+
clouds	4	4	0
big fish eating smaller fish	0	5	5+
Total	101	239	138

Items Appropriate to the Salton Sea	Pre-Drawings	Post-Drawings	Change
surfboard	4	1	-3
octopus	3	1	-2
shark	6	4	-2
jellyfish	5	4	+1
starfish	5	0	-5
coral	2	2	0
squid	1	1	0
snail	2	0	-2
turtle	1	1	0
seahorse	1	0	-1
crab	1	0	-1
whale	4	1	-3
eel	1	1	0
swordfish	1	0	-1
TOTAL	37	16	-21

appeared that were considered relevant, an increase of 138 additional items from the first to the second set of drawings. Some were unique to the Salton Sea and appeared after the students received instruction, for example: the concept of buildings underwater or the smokestack of the salt factory sticking up out of water. Again, the conclusion was that student knowledge of the Salton Sea was greatly increased as a result of reading *The Day the River Ran Away* and participating in its accompanying curriculum.

Anecdotal Evidence

The author found qualitative evidence in the classroom that awareness of the Salton Sea had entered student consciousness. At the time students were learning about the Salton Sea, they were writing paragraphs about what they hoped to learn in third grade. Five students wrote that they hoped to learn about the Salton Sea. Additionally, looking at the salt ponds created in metal pans at each table became an important classroom ritual for the students. They enjoyed seeing the salt crystals that formed on the pans, and had a raffle at the end of the project to take the pans home. One more advanced

student voluntarily made a Salton Sea diorama at home and brought it in to show the class.

Readability Analysis

A Flesch-Kincaid Grade Level Readability Formula Analysis (The Accessibility Institute, 2008) was conducted for *The Day the River Ran Away* (Table 4). The purpose of the analysis was to determine the reading grade level of the text. The first step in the analysis was to count the number of words, the number of syllables, and the number of sentences in each section. Then the average sentence length (ASL) was calculated by dividing the number of words by the number of sentences. The average number of syllables per word (ASW) was calculated by dividing the number of syllables by the number of words in each passage. Through use of the Flesch-Kincaid Readability formula $FKRA = (0.39 \times ASL) + (11.8 \times ASW) - 15.59$, the reading level was determined.

The average FKRA for *The Day the River Ran Away* is 5.71, or 5th grade reading level. Although the Salton Sea unit was designed for use in third grade, *The Day the River Ran Away* was not meant to be used for independent reading. Instead, the book was presented as a teacher

read aloud. Therefore, the fifth grade reading level was not a problem in a third grade class.

Table 4. Readability Analysis of *The Day the River Ran Away*

Flesh Grade Level Readability Formula Analysis
For
The Day the River Ran Away

SECTION	(0.39 x ASL) +	(11.8 x ASW) -	15.59 =	FKRA
Prologue - The River	5.82 +	16.8 -	15.59 =	7.10
Charles P. Rockwood	6.14 +	16.52 -	15.59 =	7.07
The Desert	4.93 +	15.81 -	15.59 =	5.15
New Liverpool Salt Company	5.00 +	14.87 -	15.59 =	4.28
Fig Tree John	7.15 +	14.27 -	15.59 =	5.83
New Liverpool Salt Company (2)	5.07 +	16.40 -	15.59 =	5.88
Southern Pacific Railroad	5.27 +	12.62 -	15.59 =	2.30
The Engineer	5.33 +	16.76 -	15.59 =	6.50
Fig Tree John (2)	3.69 +	15.99 -	15.59 =	4.09
New Liverpool Salt Works	4.97 +	15.80 -	15.59 =	5.18
Closing the Breach	6.26 +	17.7 -	15.59 =	8.37
Epilogue	6.58 +	15.81 -	15.59 =	6.80
AVERAGE	5.52 +	15.78 -	15.59 =	5.71

CHAPTER FIVE

IMPLICATIONS AND CONCLUSION

The hypothesis of the study was that student knowledge, attitudes, and awareness of the Salton Sea and its associated historical and environmental issues could be enhanced through participation in a curriculum designed specifically for third graders in the Coachella Valley. As part of the curriculum, an author-created children's book called *The Day the River Ran Away* was written.

The objective of the project was to develop a place-based curriculum that would make local students more aware of the ecological and historical background of the Salton Sea. Additional objectives were to increase student understanding of natural systems such as the water cycle and the creation of a rain shadow desert. Ecological issues included in the study were the succession of the Salton Sea area from a desert to an aquatic environment, the progression of the fish population from fresh water to salt water fish, and the emergence of the Salton Sea as important bird habitat on the Pacific Flyway. Additional ecological concerns

explored in the curriculum were the increasing salinity of the sea, the pollution entering the Salton Sea from surrounding farms and communities, and the potential future loss of habitat when water is transferred to San Diego.

The pedagogical approach developed in the project was to use a variety of instructional methods in inquiry-based lessons. The book *The Day the River Ran Away* was the literary piece around which the curriculum was based. Students actively participated in simulation games to show how succession took place for both fish and bird populations. Students conducted an experiment to show water evaporation and creation of salt deposits. Students created a timeline to show the history of the Salton Sea. Students created pictures to show what they had learned. The overall purpose of the methodology was to engage and hold student interest.

After having taught the unit, the author would make a few modifications. One revision has been discussed previously in Chapter Four. Specifically, question number two on the Salton Sea Knowledge Test was confusing and needed further refinement. During the course of the unit, the author realized that there weren't many opportunities

for the students to write. This could be remedied through inclusion of a reflection journal in which students would write what they had learned during each lesson. The unit also didn't address the flora of the Salton Sea area. An additional lesson should be created to help students see how the wetlands of the wildlife refuge areas developed and how birds depend upon plants in that environment to survive.

Despite these problems in the unit, analysis of the data shows that student awareness of the Salton Sea and its associated issues was greatly increased through participation in the Salton Sea lessons. Although the sample size (32 students) was too small to make any generalizations, facts specific to this study included an increase in student awareness that the Salton Sea exists, that it was created accidentally, that it is an important habitat for both fish and birds, and that human activities impact it. Analysis of pre- and post-unit data showed that students displayed a greater sense of personal responsibility for the Salton Sea after participating in the unit.

The implications of this study are that even students as young as third grade can grasp basic facts

about ecological systems and natural processes. Programs designed for students at this level have a greater chance of success if they use a variety of teaching methods to engage and hold student interest. Of special interest to the author was that even limited, fact-based discussion of the ecological issues associated with the project increased students' awareness and motivation to preserve the Salton Sea. When presented with the facts, even young (third-grade) students were able to develop a sense of personal interest in and sense of responsibility for the Salton Sea.

Because this project showed that environmental education about the Salton Sea could impact the awareness, knowledge and attitudes of children as early as third grade, further research needs to be conducted. Would first or second grade students benefit from targeted environmental education about the Salton Sea? Would fourth or fifth grade students become motivated to want to take action on this issue? Do attitudes toward the Salton Sea developed in childhood carry over into adolescence and adulthood? This study could become part of a longer term, longitudinal data collection of student attitudes and perceptions about the Salton Sea.

In the long run, what happens to the Salton Sea will depend upon what the citizens allow to happen. Knowledge about the problems, issues, and choices before them will help people understand the complex Salton Sea and make better choices about its future.

APPENDIX A
THE DAY THE RIVER RAN AWAY

THE DAY THE RIVER RAN AWAY

By

Kathryn Schofield

Prologue – The River

High in the Rocky Mountains of Colorado, a tiny brook bubbled out of the earth. It ran downhill and flowed past the mountain goats grazing on the tender grass of new spring. It ran past the quaking aspen shivering in the icy wind.

As the sun melted the last winter snow banks, a million creeks tumbled down the mountains, mingling their waters with the brook. The brook became a stream, and the stream became the Colorado River.

The River poured from the high mountain places, plunging over steep cliffs, dropping into broad valleys past herds of grazing elk, and plummeting into steep canyons. As it surged through the mountains, it picked up grains of sand, pieces of rocks, and even small boulders. The boulders pounded the riverbanks, and the River cut deeper and deeper into the earth.



At the bottom of the Grand Canyon

The Colorado River left the mountains and flowed across the desert, curving around and around like a twisted snake. Along the way other rivers joined it: the Yampa, the Green, and the La Sal, each carrying pieces of the mountains they had passed through. The River became deeper, wider, and as red as the fiery land surrounding it.

Down, down, down, the River cut the land. The River dug deeper and deeper, until it cut back into the very beginning of time, to some of the oldest rocks on earth resting at the bottom of the Grand Canyon.

For miles the River surged through the Canyon, surrounded by walls so steep that in places they hid the sun. The river became a boiling, pounding creature, angrily trying to claw its way out of a deep hole.



The Grand Canyon from the South Rim

Suddenly the Colorado River escaped the Grand Canyon and ran freely across flat desert land. The River carved fantastic shapes along the way: hanging rocks, domes, and needles. The thirsty land pulled at the River, trying to drink up its wetness, but the River ran on.

Then the River began to sense the sea. Huge tidal bores pushed against the current, trying to force the River back. Still the River flowed on. Finally, the River reached the Gulf of California, and its waters mingled with the waters of the ocean.

Every year, for millions of years, the Colorado River flowed from the Rocky Mountains to the Gulf of California. Then, one day, it ran away.

Charles R. Rockwood

In the year 1905, most people looked at the California desert and saw hot, sandy, lifeless land, a barrier to be crossed on the way to the rich coastal cities of Los Angeles and San Diego. Not Charles P. Rockwood. When he looked at the vast desert that stretched past the mountains east of San Diego, he had a dream. He dreamed of green fields of alfalfa, cotton, cucumbers, melons, and beans stretching as far as the eye could see. Instead of creosote bushes, lizards and coyotes, he imagined rich farmlands irrigated by water from the Colorado River.

Rockwood worked to make his dream come true. He'd formed the California Development Company. The company constructed the Alamo Canal to bring irrigation water from the Colorado River to the fields of the Imperial Valley. The canal was protected by a head gate that controlled the flow of water from the river to the fields. For several years water flowed down the Alamo canal, helping plants to grow and cities to sprout. Then trouble started. The Colorado River was full of silt. Every year, it deposited some of that silt around the head gate of the Alamo canal. Finally, the head gate was clogged and useless, and the farms started drying up. To get water flowing again, the company built a temporary head gate just south of the Mexican border.

Then something unexpected turned the Colorado into a raging torrent. Each spring the Colorado overflowed with snowmelt from the mountains upstream. In the past, the head gates of the Alamo Canal held tight against the flood. In years and years, there

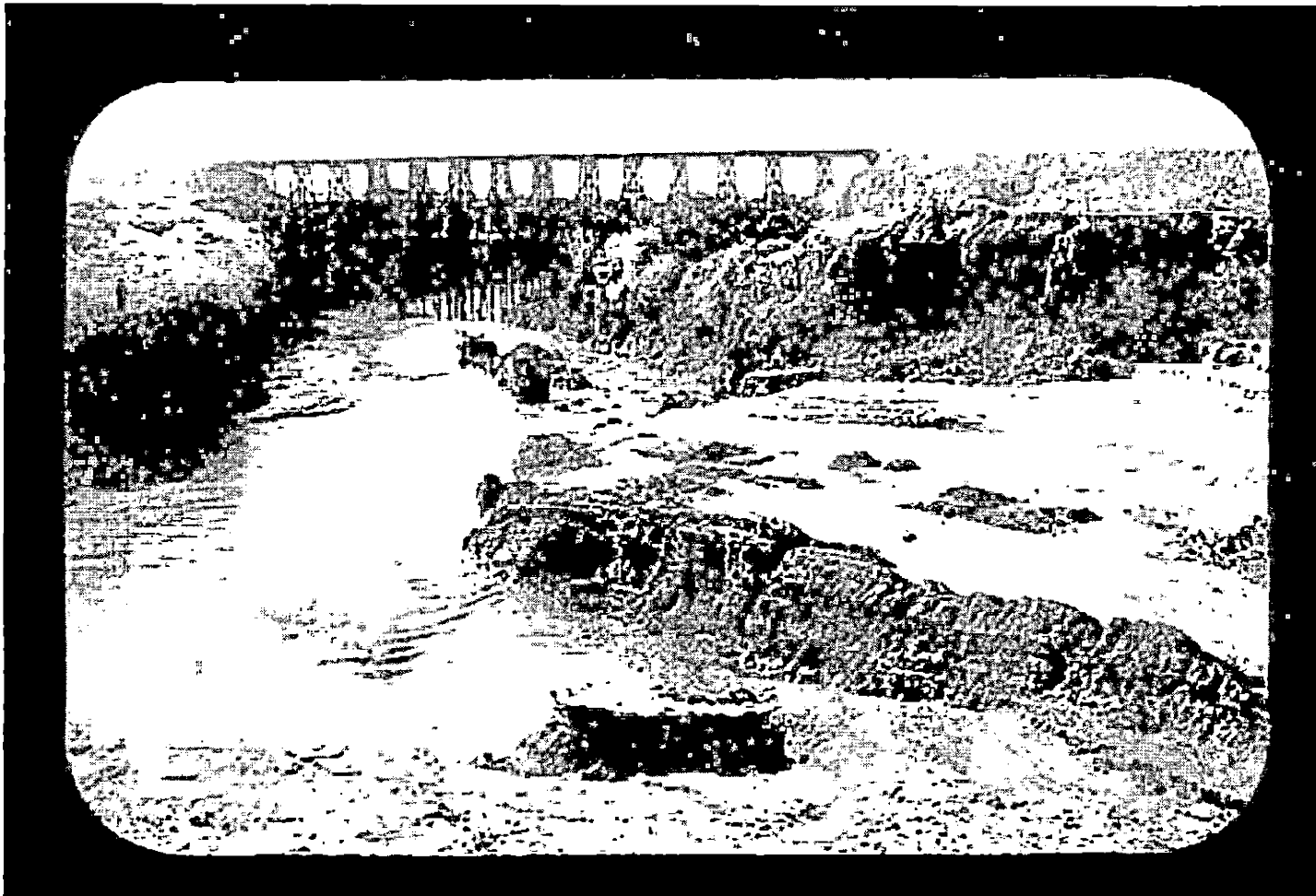
had never been a spring with more than one big flood on the river. Rockwood had been sure that the new temporary head gate that separated the canal from the main body of the river would stand against the spring flood, and it had held firm. But abruptly five other big floods roared down the river and cut into the riverbank around the gate. Under so much pounding, the head gate burst. Now the entire Colorado River was headed toward the Imperial Valley!

Rockwood thought about the homesteaders in the Imperial Valley to the west of the river. He thought about the men, women, and children who had left their homes back east, lured by dreams of owning their own farms and building a better life for their families. They had followed their dreams into the desert where summer time temperatures sometimes rose above 120 degrees. They had followed their dreams because of Rockwood and his promises that water from the Colorado River could be brought by canal to the farmlands of the Imperial Valley. He wondered what would happen to those settlers and their dreams if their homes were destroyed and their fields flooded.

Charles Rockwood ran along the banks of the Colorado River and watched his dream wash away.



Charles P. Rockwood



Alamo Channel becomes the Colorado River

The Desert

Perched on a desert willow at the edge of a wash, the red-tailed hawk was looking for food. His sharp eyes saw the enormous tortoise as it nibbled the red fruit of a prickly pear cactus. The hawk wasn't seeking the tortoise. It was large, and its hard shell protected the tortoise's body from the hawk's sharp beak. No, the hawk wanted something smaller, some juicy animal like a kangaroo rat, a lizard, or even a tasty jackrabbit. So the hawk took flight, and soared on the hot currents of air rising from the desert, flapping its wings only once in a while to change direction.

The hawk's eyes saw everything. They noticed the creosote bushes, oldest plants in the desert, with tiny dusty grey-green leaves that kept water inside. The hawk soared over the desert sand verbena, blooming like a purple carpet after the recent rains. The hawk flew above the red flowers of the ocotillo, gleaming like candles at the tip of each long stalk. But the hawk didn't eat flowers. It was looking for meat.

Far below a movement caught its eye. A coyote loped along the edge of the ravine. Long and lean, the coyote was too tough and too big for the hawk to take on. The hawk kept flying, scanning this way and that.

On the sands below a black-tailed jackrabbit rested near a creosote bush. The shadow of the hawk passed over, and the rabbit froze. Motionless except for a slight trembling of its long ears, the rabbit hoped the hawk hadn't seen it. But the hawk began circling, preparing to swoop down and grab the rabbit.

Suddenly something flashed on the arroyo below. The hawk forgot the rabbit as he turned to see an enormous wall of water pour down the wash. Brown and churning, the water swallowed everything in its path. It clawed at the walls of the gulch, tossing rocks before it, drowning the verbena, and digging through the roots of the creosote bushes. The water tore out the ocotillos, throwing them aside like javelins.

Terrified, the jackrabbit jumped for its life. In long leaps it bounded away from the torrent. For a moment it stayed ahead of the water, leaping from side to side. But the river was too fast, and it swallowed the jackrabbit. The coyote was luckier. Up on the banks of the gully, the coyote raced away at the first sound of water. It ran across the desert away from the gulch. Running at 30 miles per hour, it escaped. The slow moving tortoise could not get away. The torrent picked up the tortoise and rolled it over and over down stream. Only the hawk remained, flying above the newly created riverbed. Like thunder, the Colorado River roared into the desert.

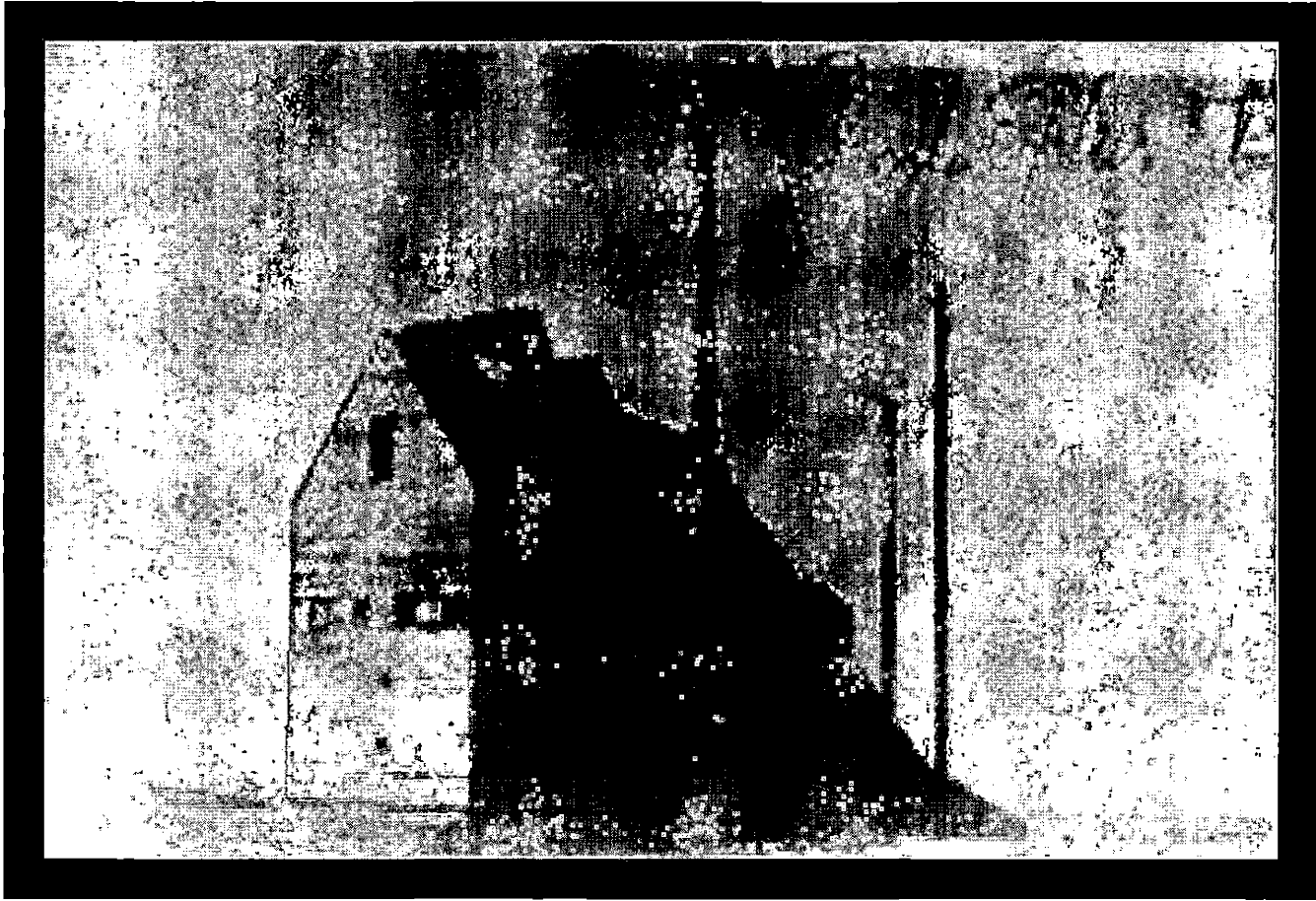


New Liverpool Salt Company

At the New Liverpool Salt Company, Gloria Torres was bringing lunch to her father. Gloria's family lived on the Torres-Martinez Reservation. They had moved from their grandfather's kish in the village to the company town built by the Salt Company. Long ago this part of the reservation was covered by a vast inland sea. As the sea dried out, the evaporating water left behind a huge deposit of salt on the earth. The New Liverpool Salt Company had hired Gloria's father and other men from the village to plow up the salt. They walked behind rows of plows pulled by cables linked to big steam engines. The plows cut wide furrows in the salt crust. The men raked up the salt, pounded the salt rocks into a powder which was then processed and shipped on the railroad to all parts of the country.

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As Gloria followed the furrow toward her father's plow, she noticed that none of the men were working. Instead they were gathered around Mr. Dubrow, the owner of the company. They looked worried. Gloria slipped to the edge of the circle and listened to Mr. Dubrow. "The telegram said that the water had bypassed Brawley, but was cutting a new river channel. The entire Colorado River's headed this way, no doubt about it. We're 264 feet below sea level. Unless somebody can get the river back to its original course, this whole operation is going to be under water! You'd better tell your families to start packing."



New Liverpool Salt Company

Fig Tree John

Meanwhile, to the west of the salt works, Juanito Razon, known to the Anglos as Fig Tree John, was working in his fig tree orchard. Fig Tree John had come to the natural spring in 1875 and had planted fig trees, turning the spring into a green oasis. Although he was old now, he still worked in the trees and greeted the few travelers who passed his way. Wearing his battered black top hat, and with a smile on his wrinkled face, he always had water and figs for his guests. Now, as he tended his orchard, he had no idea that a river was coming towards him.



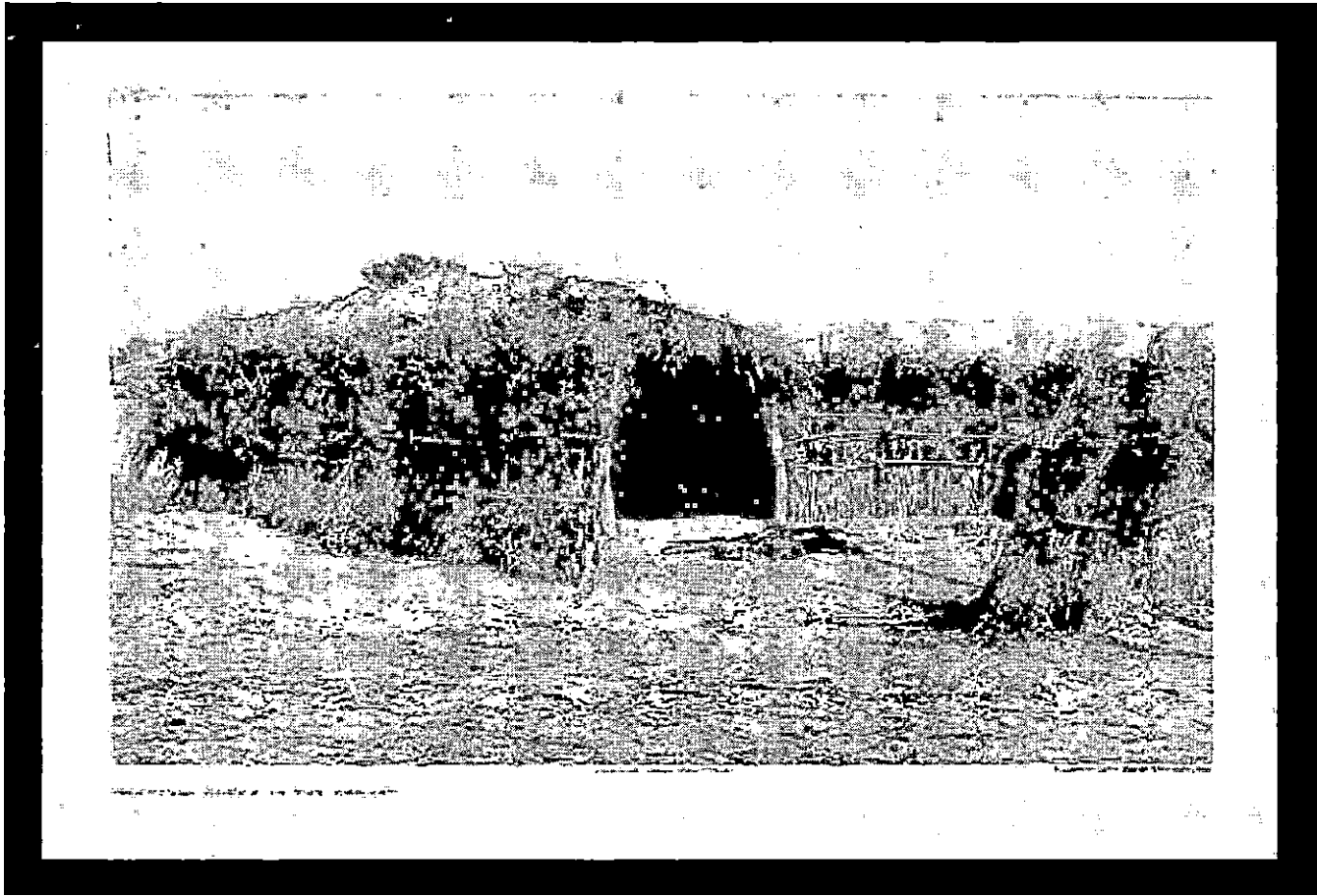
Fig Tree John

New Liverpool Salt Company

Gloria Torres watched as her father closed the front door of the house one last time. Gloria liked living in the little home in the town built by the New Liverpool Salt Company. She had enjoyed the wooden house with the floorboards that creaked when she jumped out of bed in the morning. She'd liked the windows with real glass in them that kept out the chilly winter winds. The house was so different from her grandparents' kish, a Cahuilla home made from branches covered by palm fronds. Gloria had always enjoyed going to the kish to visit her grandparents, but she was also secretly glad to get back to her real wooden home. Now she realized she would never see this house again.

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She sat in the back of the wagon with her mother and brother. The wagon was piled with everything the family owned: bedding, clothes, dishes, and even the dog. Would there be enough room in the kish? She looked around one last time, noticing that the water was getting deeper. It swirled around her father's ankles as he waded to the wagon. It was time to go. As the wagon pulled away, Gloria did not look back.



Cahuilla Kish (Home)

The Southern Pacific Railroad - 1906

E. H. Harriman was one of the most powerful men in America. He owned the railroad that connected California to the rest of the United States. But right now, Mr. Harriman didn't feel so powerful. In fact, he felt powerless. He stared at the telegram before him that came from President Theodore Roosevelt. Harriman's railroad was flooded. The Southern Pacific railroad that passed through the Salton Sink and connected Los Angeles to Arizona and the rest of the country was underwater, inundated by the Colorado River. The spur line that carried salt from the New Liverpool Salt Company was flooded too, disappearing under a new lake that was being created in the Salton Sink. President Roosevelt had sent the telegram, asking Harriman to take charge of the problem, and stop the flood. And there was absolutely nothing E.H. Harriman, sitting in his San Francisco office, could do about it. Unless. . . E.H. Harriman called his secretary and dictated a telegram to Ephs Randolph.



The Southern Pacific tracks were flooded by rising waters. They were moved to a higher location east of the Salton Sea.

The Engineer

Ephs Randolph was the best hydrological engineer in the country. A hydrological engineer is a person who designs dams. Randolph had controlled a lot of rivers by building dams across them, forming lakes that could store water for thirsty towns across the west. But Ephs Randolph had never had to stop a river from making a lake before. He stood beside the 100 feet high waterfall which the Colorado River made as it cut into its own river bank. If the river continued cutting across the land this way, it might never return to its original course. It might cut back all the way upstream to Yuma, Arizona, and wipe out the town.

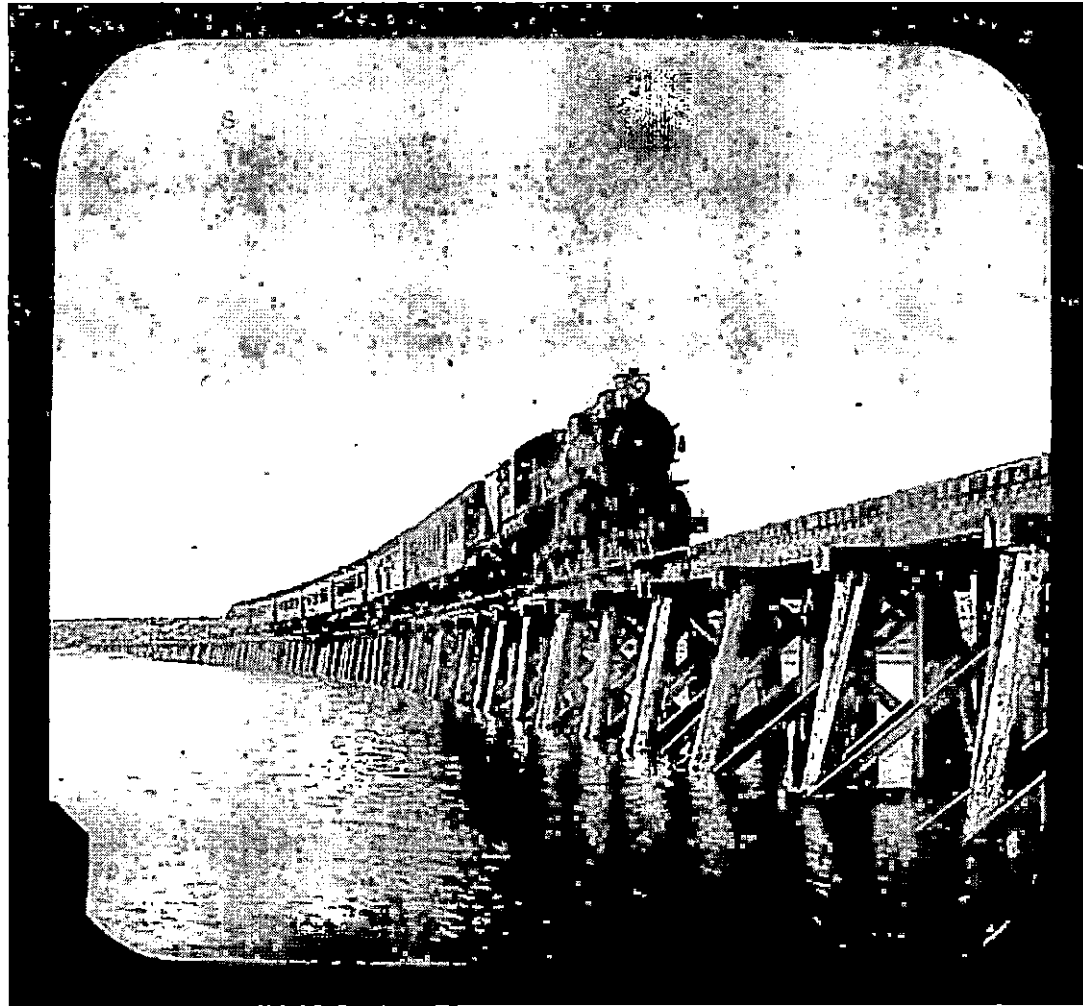
Ephs listened as E.H. Harriman told what had been done to stop the river. "At first Rockwood tried to stop the flood by putting mats and rocks across the breach. That worked for only a few days, and then the river washed it away. The directors of the Imperial Valley Development Company blamed Rockwood for the flood, and fired him. The Colorado River's been pouring water into the Salton Sink for over a year. Nobody's been able to stop it. There's a huge lake that's growing bigger every day. The railroad tracks were flooded out. We've had to build a new railroad to the east on higher ground. But if we don't stop this river, even that line may be destroyed, covered with water just like the New Liverpool Salt Works."

Fig Tree John

Fig Tree John loaded the last of his possessions on his buggy and looked one last time at his orchard. The fig trees had water halfway up their trunks. Soon they would drown under the advancing river, just like his house. Tears rolled down John's wrinkled face. He'd had a good life here. He'd worked hard in his youth to get the fig tree orchard started. Now he was old. He glanced at the cuttings wrapped carefully in wet burlap. He'd have to move near the town of Oasis and start over. Would he live long enough to enjoy the new orchard?

New Liverpool Salt Works

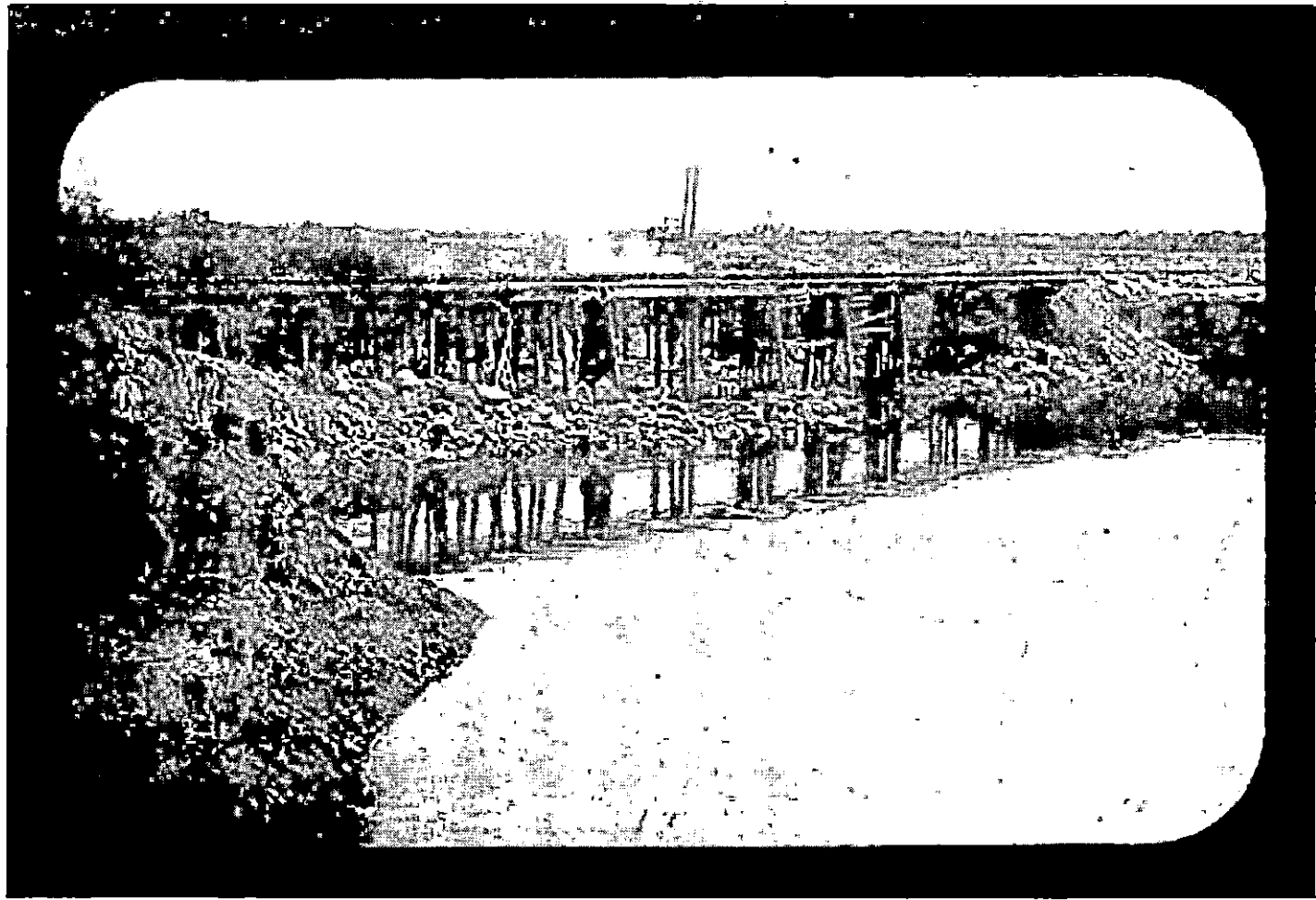
Gloria Torres had moved away from the New Liverpool Salt Works more than a year ago. Now she was traveling by train from Indio to Brawley to visit her cousin. As the train puffed down the tracks across the new Salton Sea, Gloria looked at the partially submerged telegraph poles in the water close to her. She noticed the smokestack sticking out of the water. That marked the place that had been her home. The buildings of the small company town were under water, except for the smoke stack sticking out like a ghostly finger. The conductor told her that if the Colorado kept flooding, the water might cover the towns of Mecca, Oasis, Thermal, and even Indio. Gloria wondered, "How big would this new sea become? Would it cover Grandfather's kish? Would it cover the entire reservation? Where would her people live then?"



Tracks across the Salton Sea

Closing the Breach – February 1907

Ephs Randolph and his crew of railroad workers watched the freight engine maneuver into position along side the Rockwood Gap, as the first break in the riverbank was now called. This car would be the last load of rock. During the past year, Randolph and his crew had waged a war against the Colorado River. They'd fought to close the places where the river left its original course. A special spur of the Southern Pacific Railroad had been constructed to carry enormous loads of rocks from as far as 485 miles away. The tracks had been built right over the water. Special dump cars had poured ton after ton of rocks into the breach. At first, the river fought back, cutting around the rocks, and rolling over them. However, Randolph continued the relentless dumping of rocks, 2 million cubic feet in all. Finally the river returned to its riverbed, and the water pouring down the Alamo River and the New River slowed to a trickle. As the last load of rocks was dumped, the crew cheered. The battle to tame the Colorado River was over!



Closing the Rockwood Break

Fortunately, the Colorado was stopped before it flooded Mecca and Oasis. The Torres Martinez Desert Cahuilla Reservation was not so lucky. Over 11,000 acres of tribal land were covered by water. The salt works that employed the men of the tribe was gone. The homes and farms that had once sheltered families were washed away. The Torres Martinez people would wait 90 years until they were paid for their loss.

Near Oasis, Fig Tree John had planted new trees along the Agua Dulce spring. The orchard prospered. Once again he welcomed visitors with water and figs. Only now he had more visitors, people who came to marvel at the Salton Sea, cross it on boats, and fish in its waters. Fig Tree John enjoyed his new home, and lived to be more than 90 years old.



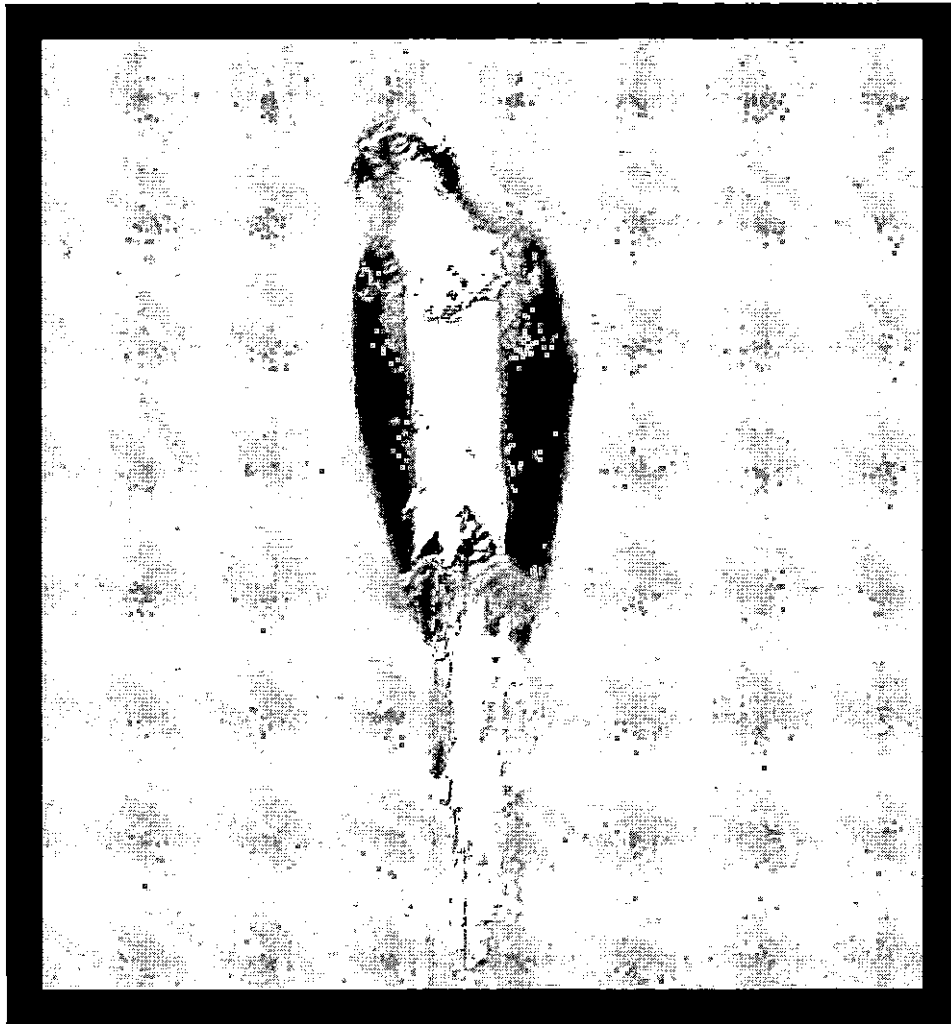
Fig Orchard in the California Desert

After Ephs Randolph closed the Rockwood Gap, the Colorado River returned to its riverbed. It rolled smoothly along side the newly created Alamo head gate. Enormous dams were built upstream to keep the River in check: at Yuma, California, Parker, Arizona, and Glen Canyon. Mightiest of all was the Hoover Dam, near Las Vegas, Nevada. With these dams in place, the Colorado was tamed. Never again has the river run away. . .yet.

What was left behind, in the lowest part of the Salton Sink, was an inland sea. The Salton Sea glistened under the California sky, 150 square miles of water at its highest point. Where once creosote bushes sheltered black tailed jackrabbits from the desert sun, fish like carp, rainbow trout, and the striped mullet that lived in the Colorado River found a new home. The fish swam among the rooftops of the New Liverpool Salt Company, wondering at their strange environment. Birds such as Great Blue Herons, Snowy Egrets, Eared Grebes, Brown Pelicans, and Canadian Geese making their way from cold northern places were amazed that instead of a barren desert beneath them, there was a sea, already developing a marshy southern edge. They made nests among the reeds and prepared for their hatchlings. The new sea brought new life to the desert.

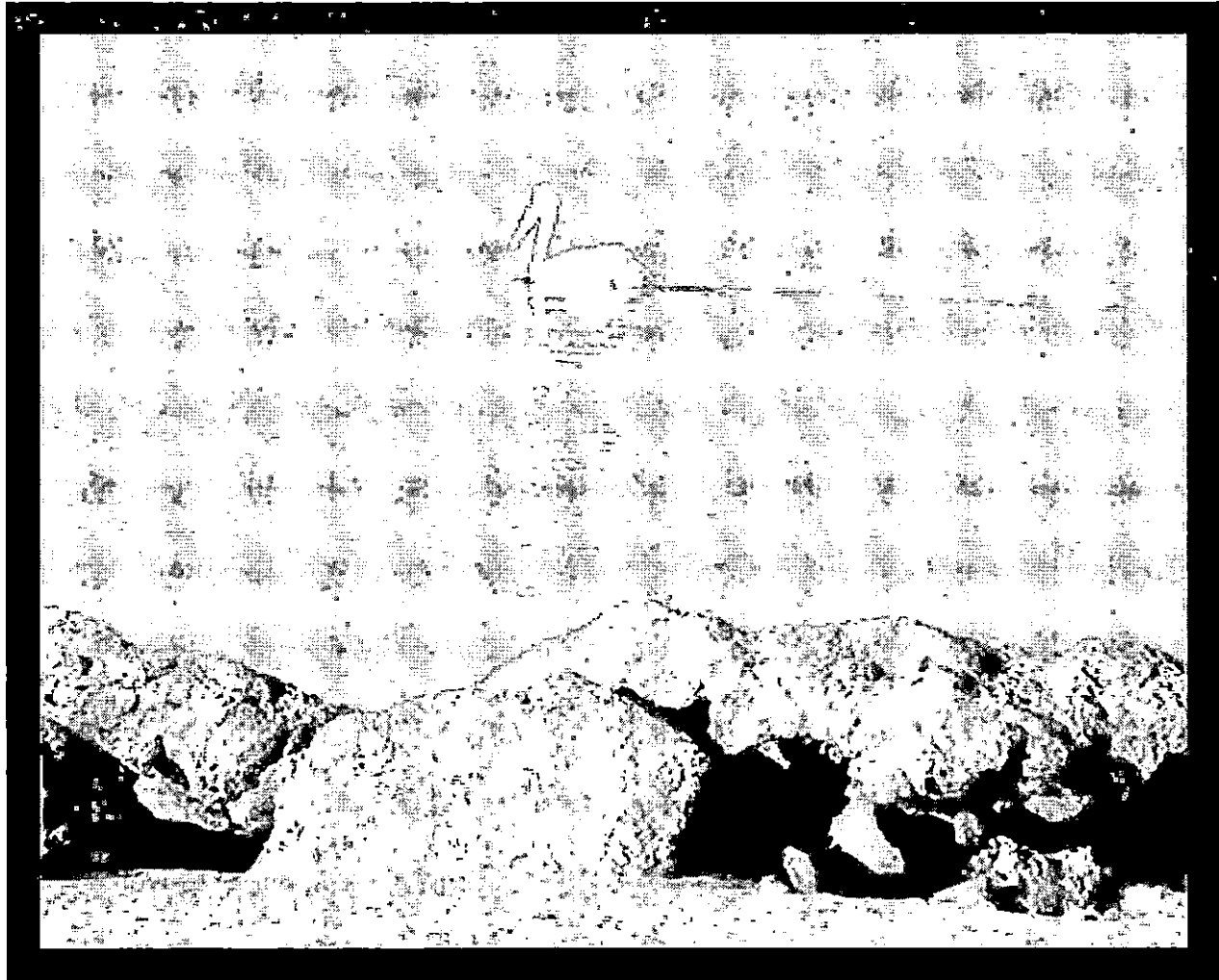
Epilogue

One hundred and one years after the Colorado River pushed out of its banks and created the Salton Sea, a lone osprey, or sea hawk, sat on the mast of the abandoned Salton Sea Beach Club. Its white underbelly made a sharp contrast with the cloak of coffee-colored feathers covering its wings. The osprey's most striking feature was the mask of brown feathers that crossed its white face. The golden eyes peering from that mask noticed every ripple on the smooth water in front of it, for the bird was looking for fish. Just below the surface of the water a movement caught its eye, and the osprey took to the air, hovering over the sea. Suddenly it dove feet first into the water, emerged with a fish in its talons, and turned its head down slightly to help balance the weight of its catch as it flew back to its roost. Safely perched again on the mast, it devoured its meal.



Osprey

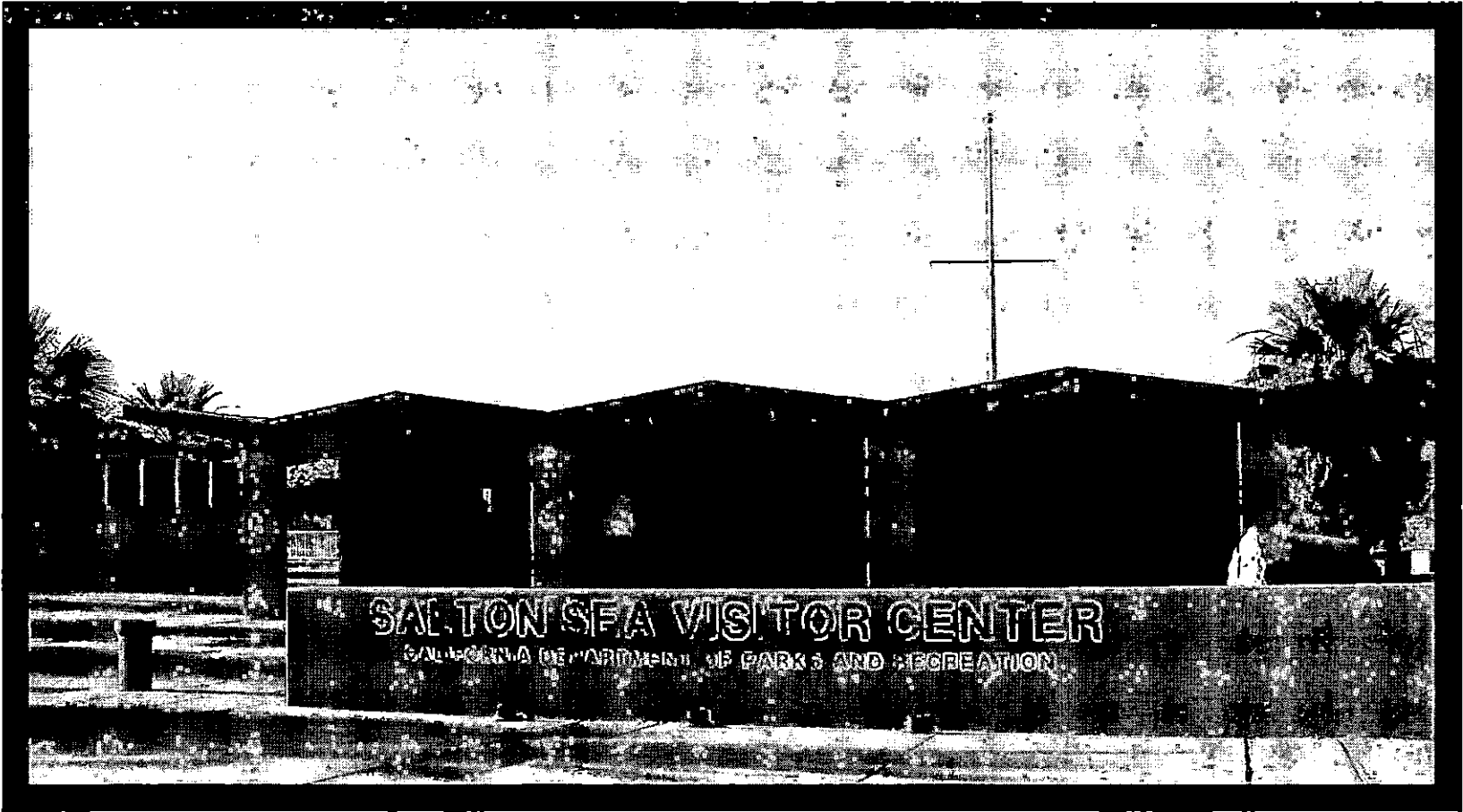
On an island formed by a breakwater about 40 yards from shore, a group of birds watched the osprey dive, then returned to preening their feathers. Their exotic shapes were outlined against the glassy water. Tallest was the great egret, its "S" shaped neck and snowy white feathers in contrast with its straight orange bill, black legs, and black feet. Next to the egret, a bittern slouched by the reeds. Its stocky brown and black body looked bottom heavy as it pointed its slender bill skyward and pretended to be a reed. At the other end of the breakwater, black-necked stilts stood on long pink legs. Their backs were black, but white feathers extended from their bellies to the necks, with a white spot just above their eyes. A pelican glided by, dipping its head underwater to scoop up fish. Seagulls wheeled overhead, their cries piercing the air. All these birds were not native to the desert, but since the creation of the Salton Sea, they had extended their range into the California desert.



Pelican

Further south, at the Salton Sea State Recreation Area, Maria Sanchez, a park ranger, walked along the beach. She felt frustrated, remembering when she was a little girl. At that time, the Salton Sea was a popular resort area. On weekends her family used to take their boat to the Salton Sea Beach Club not far from here. After launching the boat, they'd fish and go waterskiing. Now the Beach Club was boarded up and no boats disturbed the smooth water. This morning only the birds were fishing.

Maria's job today was to count the dead fish bobbing in the water. The fish died because the water of the Salton Sea was running out of oxygen. Water coming from nearby farms carried fertilizer. The fertilizer helped algae grow in the sea, which in turn took oxygen out of the water and killed the fish. Maria knew that if all the fish died, the birds that depended on them for food would die also. She looked at the black-necked stilts running in front of her. Would the birds that lived at the Sea die just as the fish were dying?



Maria knew that in 2018, water now going into the Salton Sea would go to San Diego. That meant that the sea would dry up, unless something was done to save it. If the Salton Sea dried up, the area would become a dry lake bed. Toxic clouds of dust would blow into the Coachella and Imperial Valleys, making people sick.

Maria knew that a plan was in place to make two lakes out of what was now the Salton Sea. In the north, a freshwater lake would be made for recreation, so that boating and fishing would be restored to the Salton Sea area. To the south a saltier lake would be left, and the wildlife reserves would remain as habitat for the many birds that use the Salton Sea as a stopping point on the Pacific Bird Flyway. The plan to restore the Salton Sea would cost a lot of money. Would the people of California be willing to save the Sea? Maria looked again at the smooth water before her. What would the future hold for the Salton Sea?

Glossary

Arroyo – A steep-sided dry gulch in a desert area that is wet only after heavy rain.

Brook – A small stream.

Canal – an artificial waterway constructed for use in irrigation.

Creosote bush – a resinous evergreen bush with leaves that smell like creosote.

Dump – to drop or put down something.

Engineer – a person who designs or develops something.

Epilogue – short section at the end of a book, sometimes detailing the fate of its characters.

Gulf – A large inlet of an ocean similar to a bay but often longer and more enclosed by land.

Hatchling – a bird that has just hatched from an egg.

Head gate – the gate that controls the flow of water into the upstream end of a canal lock.

Jackrabbit – A large hare with long hind legs and extremely long ears.

Marsh – An area of low-lying waterlogged land, often beside water, that is poorly drained and liable to flood.

Ocotillo – A spiny bush with red flowers at the tip of each branch.

Prologue – An introductory passage before the main action of a book.

Ravine – A deep, narrow valley, especially one formed by running water.

Riverbank – ground rising up beside a river's edge.

Red tailed hawk – a bird of prey that is active in the daytime.

Sea level – the level of the surface of the ocean relative to the land, used in calculating elevation.

Telegram – A message sent by telegraph.

Wash – the dry bed of a stream that flows only after heavy rains.

Source: Encarta Dictionary: English (North America)

Included with Microsoft Word 2007

Retrieved July 30, 2008

APPENDIX B
PARENT'S INFORMED CONSENT FORM

INFORMED CONSENT – PERMISSION TO PARTICIPATE IN THE SALTON SEA CURRICULUM RESEARCH PROJECT

I've written a book about the Salton Sea called *The Day the River Ran Away*. I'm going to read that book to the students in Room 601. Then we will study a series of six lessons about how the Salton Sea was created, the creatures that live there, their habitats, and what the Sea is like today. These lessons should be enjoyable. We will do some activities and watch a PowerPoint slide show.

This book and the accompanying lessons are part of a research project that I am doing in connection with my Master's Degree at California State University San Bernardino. The Institutional Review Board at CSUSB has approved the research, as has Madison School Principal David Karlquist.

I need your permission as well as the consent of your child so that data collected during the course of the study may be used to analyze the results of the project. The students will not be graded on these lessons. However, they will take a pretest and a post-test to see what they have learned. The results of the assessments will be used to determine the effectiveness of the book and curriculum. All data collected will be kept completely private. Students will not be identified by name.

Participation in the study is completely voluntary. You may withdraw your child from the lessons at any time. Your student will not be asked to do anything in connection with these lessons that would be different from what he/she does in the regular course of instruction. There are no foreseeable risks to students as a result of participation in this project. During the course of the research, I will not use your student's name, address, or any other personal information. Confidentiality and anonymity will be maintained at all times, and at the end of the study, I will destroy all student work that came from the program.

If you prefer that your student not participate, let me know and I'll make arrangements for the student to go in another classroom while the Salton Sea instruction takes place. However, if you give your permission for me to use the data collected from the classroom in my study, please sign below in the space provided. Then return the form to me in Room 601. Call me at (760) 775-3850 if you have any questions.

Thank you,

Mrs. Kathryn Schofield

I give my consent for data collected from my child's participation in the Salton Sea lessons in Room 601 to be used in the Salton Sea Research Project.

Child's Name _____

Parent's Signature _____

INFORMACION DE CONSENTIMIENTO-PERMISO PARA PARTICIPAR EN EL PROYECTO DE CURICULUM DE INVESTIGACION DE LA LAGUNA SALTON SEA

Durante las lecciones de Estudios Sociales y Ciencias del salón 601 de este año, usaremos seis lecciones nuevas sobre la Laguna Salton Sea. Estas lecciones son parte de proyecto de desarrollo efectivo del currículo de la Laguna Salton Sea la cual hago en conexión con mi Maestría con la Universidad Estatal de San Bernardino. La mesa de Repasos Institucional CSUSB ha aprobado esta investigación. Las lecciones se combinan con los programas de estudios sociales y ciencias ya implementados en nuestra clase. Esto solamente expande el programa incluyendo mas información específica sobre la laguna Salton Sea que es incluido en el texto. Cada una de las seis lecciones tomo 45 minutos y tomara lugar durante la tarde después del último recreo.

Pero, yo necesito su permiso, tanto como el permiso de su niño/a para ser parte de la lección... La participación en este estudio es completamente voluntaria. Puede retirar a su hijo de esta lección cuando usted guste. No se le pedirá a su hijo/a que haga algo que no hace en el curso regular de instrucción. Tampoco se la dará calificación como parte de esta lección. No habrá riesgos forzados para los estudiantes como resultado de su participación en este proyecto. Durante el curso de la investigación, no usare ni el nombre o el domicilio de su hijo/a o cualquier información personal. Se mantendrá confidencia y anonimia todo el tiempo, al final del programa destruiré el trabajo de los estudiantes que proviene de durante este programa.

Si usted prefiere que no participe su estudiante, déjemelo saber, yo haré los arreglos necesarios para que su estudiante vaya a otro salón durante la instrucción de la laguna de Salton Sea. Aunque si usted quiere que su estudiante aprenda los interesantes factores de geología, historia y ecología de la laguna Salton Sea, la cual es una parte importante de nuestra región, por favor firme en el espacio proveído. Entonces regrese la forma al salón 601. Llámeme al (760) 775-3850 si tiene alguna pregunta.

Muchas gracias,

Sra. Kathryn Schofield

Doy mi consentimiento para (nombre del estudiante) _____ participar en las seis lecciones de la laguna Salton Sea del proyecto de currículo de de la clase de la Sra. Schofield.

Firma del padre _____

Fecha _____

APPENDIX C

CHILD'S ASSENT TO PARTICIPATE IN STUDY FORM

CHILD ASSENT TO PARTICIPATE IN STUDY

September 2, 2008

Dear Students,

Would you believe Mrs. Schofield is still going to school? I am studying for a Master's Degree in Education at California State University in San Bernardino. As part of my "homework," the University has allowed me to do a project about the Salton Sea. I'm asking you to help with the project by participating in some lessons.

I've written a book about the Salton Sea called *The Day the River Ran Away*. I'm going to read that book to you students. Then we will study a series of lessons about how the Salton Sea was created, the creatures that live there and their habitats, and what the Sea is like today.

These lessons should be enjoyable. We will do some activities and watch a PowerPoint slide show. You will not be graded on these lessons. Nothing in the lessons involves harm to you. All information about you will be kept completely private. Your name will not be used.

You will not get in any trouble if you do not want to participate in the lessons. I will just ask Mrs. Jones to let you come with her class during the times that we are studying about the Salton Sea. However, if you want to take part in the study about the Salton Sea, and will allow information collected from you to be used in the study, please sign your name and fill in the date on the lines below.

Sincerely,

Mrs. Schofield

Yes, I want to take part in the lessons about the Salton Sea.

Name _____

Date _____

APPENDIX D

THE DAY THE RIVER RAN AWAY UNIT CORRELATION TO
CALIFORNIA STATE ENVIRONMENTAL EDUCATION
PRINCIPLES AND THIRD GRADE STANDARDS

THE DAY THE RIVER RAN AWAY

UNIT OVERVIEW: CORRELATION OF CALIFORNIA ENVIRONMENTAL EDUCATION PRINCIPLES AND THIRD GRADE STANDARDS

- I. **Pre-assessment/ Introduction: *The Day the River Ran Away***
Lesson One
 - A. Reading Comprehension Standard 2.0 – Students read and understand grade-level appropriate material. They draw upon a variety of comprehension strategies as needed (e.g., generating and responding to essential questions, making predictions, comparing information from several sources.)
 1. 2.2 – Ask questions and support answers by connecting prior knowledge with literal information found in, and inferred from, the text.
 2. 2.3 – Demonstrate comprehension by identifying answers in the text.
 3. 2.4 – Recall major points in the text and make and modify predictions about forthcoming information.
 4. 2.6 – Extract appropriate and significant information from the text, including problems' and solution

- II. **From the Desert to the Sea: Formation of the Salton Sea**
Lesson Two
 - A. E.E. Principle II – The long-term functioning and health of terrestrial, freshwater, coastal and marine ecosystems are influenced by their relationship with human communities.
 1. Concept a - Students need to know that direct and indirect changes to natural systems due to the growth of human populations and their consumption rates influence the geographic extent, composition, biologic diversity, and viability of natural systems.
 2. Concept b - Students need to know that the methods used to extract, harvest, transport, and consume natural resources influence the geographic extent, composition, biologic diversity, and viability of natural systems.

- B. Social Studies Standard 3.1 – Students describe the physical and human geography and use maps, tables, graphs, photographs, and charts to organize information about people, places, and environments in a spatial context.
 - 1. 3.1.1 – Identify geographical features in their local region (e.g., deserts, mountains, valleys, hills, coastal areas, oceans, lakes).
 - 2. 3.1.2 – Trace the ways in which people have used the resources of the local region and modified the physical environment (e.g., a dam constructed upstream changed a river or coastline.)

II. **Salton Sea: Water Cycle in a Rain Shadow Desert**

Lesson Three

- A. E.E. Principle III – Natural systems proceed through cycles that humans depend upon, benefit from, and can alter.
 - 1. Concept a - Students need to know that natural systems proceed through cycles and process that are required for their functioning.
 - 2. Concept c - Students need to know that human practices can alter the cycles and processes that operate within natural systems.
- B. Physical Sciences Standard 1 – Energy and matter have multiple forms and can be changed from one form to another.
 - 1. 1.a – Students know energy comes from the Sun to Earth in the form of light.
 - 2. 1.e – Students know matter has three forms: solid, liquid, and gas.
 - 3. 1.f – Students know evaporation and melting are changes that occur when objects are heated.

IV. Salton Sea: Whose Habitat is That?

Lesson Four

- A. E.E. Principle IV – The exchange of matter between natural systems and human societies affect the long-term functioning of both.
 - 1. Concept a - Students need to know that the effects of human activities on natural systems are directly related to the quantities of resources consumed and to the quantity and characteristics of the resulting byproducts.
 - 2. Concept b - Students need to know that the byproducts of human activity are not readily prevented from entering natural systems and may be beneficial, neutral, or detrimental in their effect.
 - 3. Concept c - Students need to know that the capacity of natural systems to adjust to human-caused alterations depends on the nature of the systems as well as the scope, scale, and duration of the activity and the nature of its byproducts
- B. Life Sciences Standard 3 – Adaptations in physical structure or behavior may improve an organism’s chance for survival.
 - 1. 3.b – Students know examples of diverse life forms in different environments, such as oceans, deserts, tundra, forests, grasslands, and wetlands.
 - 2. 3.d – Students know when the environment changes some plants and animals survive and reproduce; other die or move to new locations.

V. People and the Salton Sea: Yesterday, Today, and Tomorrow

Lesson Five

- A. E.E. Principle V - Decisions affecting resources and natural systems are based on a wide range of considerations and decision-making processes. As a basis for understanding this principle:
 - 1. Concept b - Students need to know the process of making decisions about resources and natural systems, and how

the assessment of social, economic, political, and environmental factors has changed over time.

- B. Social Studies Standard 3.3.3 – Trace why the community was established, how individuals and families contributed to its founding and development, and how the community has changed over time, drawing on maps, photographs, oral histories, letters, newspapers, and other primary sources.

VI. Review and Post-Assessment

APPENDIX E
SALTON SEA AWARENESS AND ATTITUDE SURVEY

SALTON SEA AWARENESS AND ATTITUDES ASSESSMENT

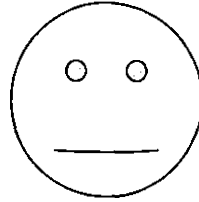
Instructions: Circle the face which best answers the question.

1. I have heard of the Salton Sea.

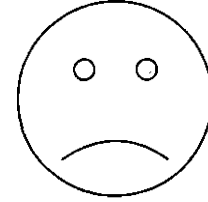
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Disagree

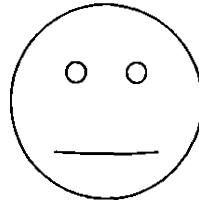


2. The Salton Sea is near my home.

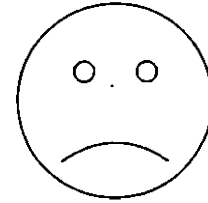
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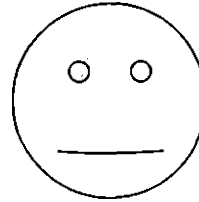


3. Sometimes the Salton Sea smells bad.

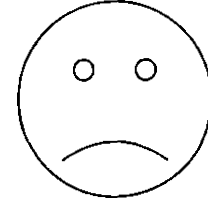
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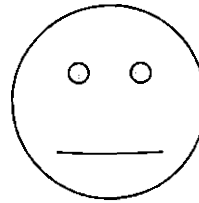


4. I would like to visit the Salton Sea.

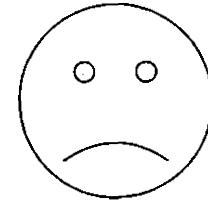
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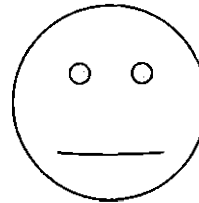


5. The Salton Sea is important because many birds live there.

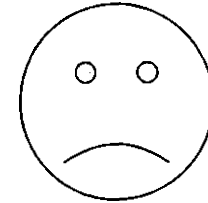
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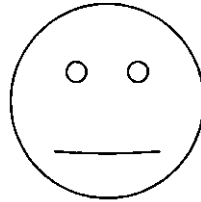


6. The Salton Sea is important because many fish live there.

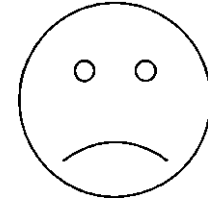
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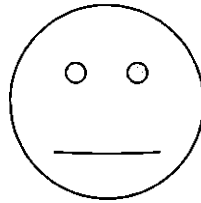


7. The Salton Sea can be a fun place to visit.

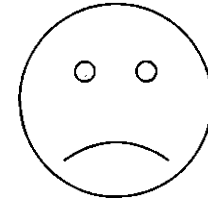
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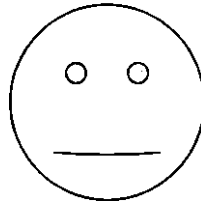


8. I think that the Salton Sea is polluted.

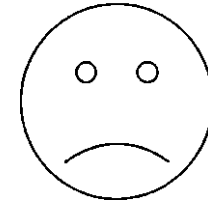
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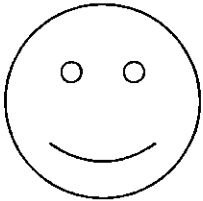


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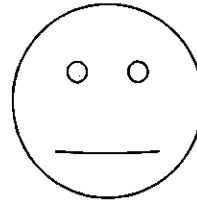


9. The Salton Sea is beautiful.

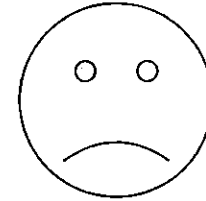
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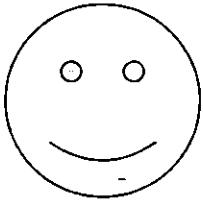


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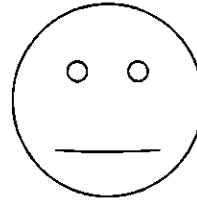


10. The Salton Sea is important to me.

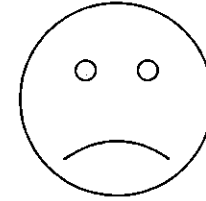
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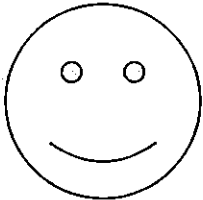


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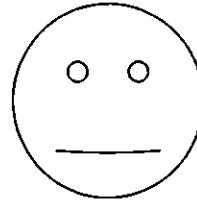


11. The Salton Sea is ugly.

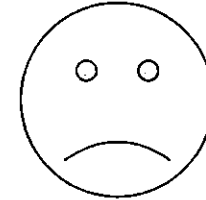
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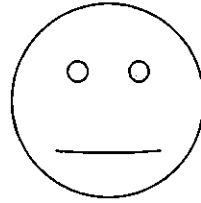


12. It is dangerous to eat the fish from the Salton Sea.

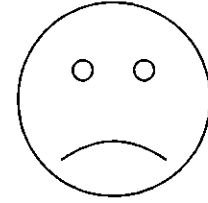
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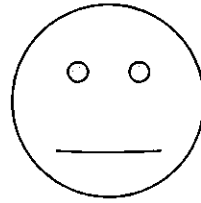


13. People should take care of the Salton Sea.

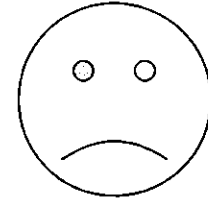
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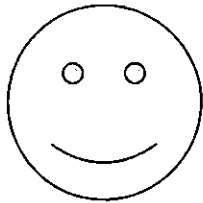


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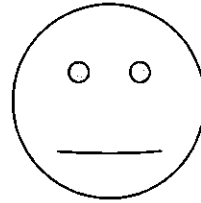


14. The Salton Sea has always been there.

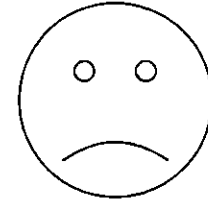
Agree



I don't know.



Disagree

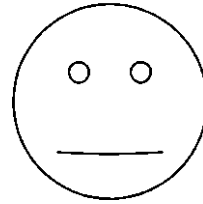


15. The Salton Sea may someday dry up.

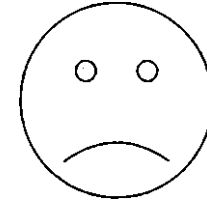
Agree



I don't know.



Disagree



APPENDIX F
SALTON SEA KNOWLEDGE TEST

SALTON SEA KNOWLEDGE ASSESSMENT

Directions: Listen as the teacher reads each question and its answer choices. Circle the letter of the correct answer.

1. The Salton Sea was created when:
 - a. The Colorado River broke through the head gate of a canal and rushed into the Salton Sink.
 - b. A flood came out of the mountains.
 - c. A series of storms dumped a lot of rain.
2. The Salton Sink is:
 - a. An area of land that was once the floor of an inland sea.
 - b. An area of land between mountain ranges.
 - c. All of the above.
3. The Salton Sea is in a desert because:
 - a. It is the only place that snakes live.
 - b. It never rains there.
 - c. It is in the "rain shadow" of the mountains.
4. The Salton Sea took almost:
 - a. Two years to form.
 - b. Two hundred years to form.
 - c. Two thousand years to form.
5. The Salton Sea is an important stop on the:
 - a. Pacific Flyway for birds.
 - b. Trans-Canadian Highway.
 - c. Road to Morocco.
6. The Salton Sea is critical habitat for:
 - a. Large animals such as deer, mountain lions, and bears.
 - b. Small animals such as squirrels, rabbits, and chipmunks.
 - c. Over 200 species of birds.
7. Water comes into the Salton Sea mostly from:
 - a. Rain.
 - b. Water coming from surrounding farms.
 - c. The Pacific Ocean.

8. You might find these creatures in the desert around the Salton Sea:
 - a. Lions, tigers, and bears.
 - b. Kangaroos, koala bears, and crocodiles.
 - c. Lizards, snakes, and red-tailed hawks.

9. The Salton Sea may get smaller by the year 2013 because:
 - a. It will never rain again in the desert.
 - b. Water now going into the Salton Sea will be sent to San Diego.
 - c. All of the above.

10. Two of the most polluted rivers in the United States are the:
 - a. Mississippi and Missouri Rivers.
 - b. Snake and Yellowstone Rivers.
 - c. Alamo and New Rivers.

11. Choose which body of water is saltiest.
 - a. The Pacific Ocean.
 - b. The Salton Sea.
 - c. Big Bear Lake.

12. The beaches at the Salton Sea are made of:
 - a. Tufa, a kind of salt.
 - b. Sand.
 - c. Volcanic glass.

13. The first fish in the Salton Sea were:
 - a. Freshwater fish such as rainbow trout.
 - b. Salt water fish such as tilapia and corvina.
 - c. Goldfish.

14. The kind of fish that can live in the Salton Sea now are:
 - a. Freshwater fish such as rainbow trout.
 - b. Salt water fish such as tilapia and corvina.
 - c. Goldfish.

15. The Salton Sea is near the cities of:
 - a. Indio, Mecca, Thermal, and Brawley
 - b. Los Angeles, Glendale, and Long Beach
 - c. San Francisco, Walnut Creek, and Oakland.

APPENDIX G

PICTURE ASSESSMENT: DRAW WHAT YOU KNOW
ABOUT THE SALTON SEA

Draw a picture that shows everything you know about the Salton Sea.

APPENDIX H

THE DAY THE RIVER RAN AWAY LESSON ONE

I, Pre-assessment/ Introduction: *The Day the River Ran Away*

California Standards

- A. Reading Comprehension Standard 2.0 – Students read and understand grade-level appropriate material. They draw upon a variety of comprehension strategies as needed (e.g., generating and responding to essential questions, making predictions, comparing information from several sources.)
1. 2.2 – Ask questions and support answers by connecting prior knowledge with literal information found in, and inferred from, the text.
 2. 2.3 – Demonstrate comprehension by identifying answers in the text.
 3. 2.4 – Recall major points in the text and make and modify predictions about forthcoming information.
 4. 2.6 – Extract appropriate and significant information from the text, including problems and solutions.

Objectives

1. The students will demonstrate prior knowledge about the Salton Sea by drawing a picture that shows everything they know about the Salton Sea.
2. The students will respond in writing to a teacher-read attitude survey about the Salton Sea.
3. Students will prepare a list of what they know about the Salton Sea.
4. Working with partners, students will prepare a list of questions telling what they would like to know about the Salton Sea.
5. The students will listen to a read-aloud called *The Day the River Ran Away*.
6. During the read-aloud, the students will make predictions and respond to questions about the text.
7. After the read-aloud, students will recall major points in the text.
8. As a group, the students will prepare a summary of events in the story, including the problem and solution in the text.

Materials and Setup

1. Book: *The Day the River Ran Away*
2. Plain sheet of paper titled, "Draw a picture that shows everything you know about the Salton Sea."
3. Salton Sea Attitude Survey.
4. Chart paper and markers.
5. Writing paper.

Timeframe

1. Day One Pre-assess, Engage & Explore – Approximately 45 minutes.
2. Day Two – Explore – Read and discuss *The Day the River Ran Away* - Approximately 45 minutes.

Engage

1. Questions: "Have you ever been to the Salton Sea?" "What did you see there?"
2. "Today I want you to draw a picture that shows everything you know about the Salton Sea. You may write the names of the things you draw in the picture."
3. "As I read the statements in the Salton Sea Survey, circle the face that tells how you feel about the sentence." Demonstrate on white board.

Explore

1. Class brainstorms a chart "What we know about the Salton Sea."
2. Working as partners, students brainstorm questions "What We want to know about the Salton Sea."
3. Students share questions with class and teacher records the questions on a "What We Want to Know About the Salton Sea Chart."
4. Teacher Read-Aloud: *The Day the River Ran Away*. (Approximately 15 minutes.)

Questions:

1. Knowledge – Where does the Colorado River begin?
Through what states does the Colorado River flow?
Where is the Salton Sea? How was the Salton Sea formed? In what year did the Colorado River run away? Who was Fig Tree John? What happened to Fig Tree John's fig orchard? Where did

- Gloria Torres live? What happened to the New Liverpool Salt Works? Who did E.H. Harriman choose to stop the flooding? How was the flood on the Colorado River stopped? How many years did it take to stop the flood?
2. Comprehension – What was this story about? What did Fig Tree John look like? Why did President Roosevelt think that E.H. Harriman was the right person to stop the flooding? Why did it take so long to stop the flood?
 3. Application – What did the desert look like before the Colorado River flooded? What did it look like after the Salton Sea was created?
 4. Analysis – How do you think Fig Tree John felt when he had to leave his orchard? How do you think Gloria Torres felt when she looked out of the train window and saw the chimney of the New Liverpool Salt Works sticking up out of the water? How do you think people felt when the flood was stopped?
 5. Synthesis - List the events of this story in sequence.
 6. Evaluation – Do you think that a river could run away today and cause a flood?

Explain

1. Teacher-led discussion recorded on chart paper: What was the problem in the story *The Day the River Ran Away*? How was the problem solved?

Sample answer:

The Colorado River ran away.	
A head gate broke.	The river changed direction.
The river flowed into the Salton Sink.	It made a lake called the Salton Sea.
Hank Eps stopped the flood by dumping rock from railroad cars into the gap.	Even though the flooding stopped, the Salton Sea remained.

2. Class refers to “What We Want to Know about the Salton Sea Chart” and answers questions explained by the book.
3. Class records additional questions raised by the book.

Extend

1. Students write a simple paragraph in response to: How would you have felt if your home was destroyed like the home of the red-tailed hawk, Gloria Torres, or Fig Tree John? Why would you feel that way? (Approximately 20 minutes.)
2. Students share paragraphs with partners.

Evaluate

1. Informal evaluation of students' oral responses for evidence that students know how the Salton Sea was created.
2. Student-created paragraphs show that students understand that dislocation caused by the flooding was stressful for individuals.

APPENDIX I

THE DAY THE RIVER RAN AWAY LESSON TWO

From the Desert to the Sea: Formation of the Salton Sea

California Standards and Environmental Principles

- A. E.E. Principle II – The long-term functioning and health of terrestrial, freshwater, coastal and marine ecosystems are influenced by their relationship with human communities.
 - 1. Concept a - Students need to know that direct and indirect changes to natural systems due to the growth of human populations and their consumption rates influence the geographic extent, composition, biologic diversity, and viability of natural systems.
 - 2. Concept b - Students need to know that the methods used to extract, harvest, transport, and consume natural resources influence the geographic extent, composition, biologic diversity, and viability of natural systems.

- B. Social Studies Standard 3.1 – Students describe the physical and human geography and use maps, tables, graphs, photographs, and charts to organize information about people, places, and environments in a spatial context.
 - 1. 3.1.1 – Identify geographical features in their local region (e.g., deserts, mountains, valleys, hills, coastal areas, oceans, lakes).
 - 2. 3.1.2 – Trace the ways in which people have used the resources of the local region and modified the physical environment (e.g., a dam constructed upstream changed a river or coastline.)

Objectives

- 1. The students will explore the impact of human activities upon bird migration patterns by playing the game “Migration Headache.”
- 2. The students will label a map of the Salton Sink, including the Chocolate Mountains; the U.S. Mexican border; Anza-Borrego State Park; the Salton Sea; the Salton Sea State Park; the wildlife refuge areas, the Coachella Valley and the Imperial Valley
- 3. The students will draw murals comparing how the Salton Sink looked before and after the formation of the Salton Sea.

Materials and Setup

1. Book: *The Day the River Ran Away*
2. Large sheets of white bulletin board paper, sized for classroom display.
3. Crayons, paints, or colored pencils.
4. Map of Salton Sea area both as slide and worksheet.
5. Paper plates or carpet squares to use as bases.

Whistle

Timeframe

Game and Discussion – Approximately 45 minutes.

Label map and draw murals. Approximately 45 minutes.

Engage

1. Reread pages 11 and 12 in *The Day the River Ran Away*.
Question: Before the Salton Sea was formed, what kinds of birds lived in the desert? Show slides of red-tailed hawk, roadrunners, Gambel quail, etc. What kinds of plants grew there? Show slides of creosote bush, ocotillo, cholla, etc.
2. Read pages 31 – 34 in *The Day the River Ran Away*. Show slides of osprey, ducks, geese, herons, rails, terns, and plovers. These are birds whose habitat is the Salton Sea. Where did these birds come from? (Students should generate the idea that the bird flew there.) Why didn't these birds stay in the Salton Sink before the Salton Sea was formed? Show slides of wetland habitat along the edge of the sea.

Explore

1. Play the game "Migration Headache" adapted from Project Wild Aquatic (2005). Lay out a large playing area, about 70 feet in length if possible. At one end is wintering habitat. The middle is stopover habitat, and the other end is nesting habitat. Use paper plates or carpet squares as bases. There should be one base for each 2 students. Distribute the bases evenly in the three areas. The bases represent wetlands that provide suitable habitat for water birds. Students represent water birds and will migrate between bases when the teacher blows the whistle. Students are to walk, not run. At the end of each migration, students are to have one foot on a base to survive and continue the game. Only two people can survive on one base.

2. Explain to the students that many factors will determine who survives. These factors include changes in the wintering grounds, stopover areas, or nesting habitats. There will be times when food, water, shelter, and space are suitably arranged for survival. There will be other times when the habitat is stressed, and many factors limit the birds survival.
3. All students begin at the wintering habitat. Blow the whistle and allow the students to migrate to the stopover habitat. Explain that most water birds need these areas to rest and eat before continuing their journey.
4. Blow the whistle and allow the students to migrate to the wintering habitat. Explain that there has been no loss of food, water, shelter, and space on the migration and a successful season is at hand.
5. Before the students return "south" remove one base. Explain that a developer has received a permit to drain a wetland to build a mall. Have students migrate to the stopover. Explain that the birds that didn't find a base died from loss of habitat. Those students go to the sidelines, but may return as hatchlings when favorable conditions (more bases) prevail.
6. Play the game using the habitat scenarios.

Explain

1. Explain the idea of migration. Birds nest and raise their young in the north during the warm summer months, and travel hundreds or thousands of miles south to live in winter. Stopovers are resting places for migrating birds. Many birds use the Salton Sea as wintering grounds or stopovers on the Pacific Flyway.
2. After the activity, ask the students to identify factors that cause water bird populations to decline or increase, Which factors were natural? Which were caused by humans? What are the problems or benefits related to these factors for the community?
3. Using the overhead slide of the Salton Sink, and the map handout, students identify, discuss and label the Chocolate Mountains; the U.S. Mexican border; Anza-Borrego State Park; the Salton Sea; the Salton Sea State Park; the wildlife refuge areas, the Coachella Valley and the Imperial Valley.

Extend

1. Students will work in groups of four. In each group, two people will draw a mural of the Salton Sink before the formation of the sea, and two will draw a picture of the Salton Sink after the sea was formed. Students are to include the appropriate plants and animals.

Evaluate

1. Informal evaluation of responses to questions to show evidence that students know that humans changed the Salton Sink, that birds migrate, that the Salton Sea is an important stop on the Pacific Flyway.
2. Murals show evidence that students understand that the desert changed to a wetlands with the creation of the Salton Sea, and that plants and animal life changed as a result.

Habitat Scenarios

- Polluted water enters the Salton Sea from agricultural runoff. Remove one habitat from the wintering habitat.
- The desert has several really wet rainy seasons and the water level of the sea increases slightly. Add one habitat to the wintering habitat.
- A landowner has agreed to re-flood fields after harvesting, increasing acreage in the stopover habitat. Add one habitat to the stopover habitat.
- The avian flu strikes birds at the Salton Sea. Remove two habitats from the wintering habitat.
- There is a fish die-off at the Salton Sea, reducing the food available for some kinds of birds. Remove two habitats from the wintering habitat.
- New laws restrict motorboat traffic on a number of nesting habitat lakes. Add one habitat to the nesting habitat.
- A marsh has been dredged to build a marina. Remove one habitat from the nesting habitat.
- A new water treatment plant is completed to treat the water of the New River. Add one habitat to the wintering habitat.
- A timber company has agreed to preserve a forested wetland in exchange for tax credits. Add one habitat to the stopover habitat.
- Several dry years causes the water level of the sea to go down. Remove one habitat from the wintering habitat.
- San Diego starts pumping water out of the Salton Sea. Remove two habitats from the wintering habitat.
- Los Angeles puts some water back in Owens Lake. Add one habitat to the stopover habitat.

APPENDIX J

THE DAY THE RIVER RAN AWAY LESSON THREE

III. Salton Sea: Water Cycle in a Rain Shadow Desert

California Standards and Environmental Principles

- A. E.E. Principle III – Natural systems proceed through cycles that humans depend upon, benefit from, and can alter.
 - 1. Concept a - Students need to know that natural systems proceed through cycles and process that are required for their functioning.
 - 2. Concept c - Students need to know that human practices can alter the cycles and processes that operate within natural systems.

- B. Physical Sciences Standard 1 – Energy and matter have multiple forms and can be changed from one form to another.
 - 1. 1.a – Students know energy comes from the Sun to Earth in the form of light.
 - 2. 1.e – Students know matter has three forms: solid, liquid, and gas.
 - 3. 1.f – Students know evaporation and melting are changes that occur when objects are heated.

Objectives

- 1. The students will work in groups to conduct an experiment.
- 2. Students will make a salt evaporation pond in a small aluminum loaf pan.
- 3. Students will formulate a hypothesis and record observations in a science journal.
- 4. Students will label the parts of the water cycle on a graphic organizer.
- 5. Students will draw and label a picture of the rain shadow effect.

Materials and Setup

For each Group of Four Students:

1. 1 aluminum foil 3x5 loaf pan.
2. 1 cup of water
3. $\frac{1}{4}$ cup of Salt.
4. Science journal for each student.
5. Water cycle worksheet for each student.

Students work in groups of 4 with these roles: supply person (gets all supplies), scribe (records groups questions and observations), communicator (directs any questions to the teacher, make sure everyone has a turn to speak), and clean-up (puts everything in its place after the experiment is over.)

Timeframe

Creation of "Salton Sea" in pans – Approximately 20 minutes.

Water cycle demonstration on computer and worksheet– Approximately 25 minutes.

Interval between creation of "Salton Sea" and total evaporation – Approximately one week.

Observation, journal entries, tufa and rain shadow desert lesson – Approximately 45 minutes.

Engage

1. Have you ever wondered why the Salton Sea is salty? Today we are going to find out by making a little Salton Sea in a pan.
2. Each group will put 1 cup of water in a 3x5 aluminum loaf pan. Then the group measure how deep the water is, and records it in the journal. The group adds $\frac{1}{4}$ cup salt and measures how deep the water is. Then the group will put the pan on a waterproof tray, careful not to spill any water, and set it aside in a warm place where evaporation can take place.

Explore

1. During the next few sessions, the students observe changes in the pan. Keep the pans until the water has evaporated.
2. The students measure the depth of the water in the pan, and use the measuring cup to see how much water remains. They then subtract from the original amount to determine how much has evaporated. Students record their measurements in the science journal, and formulate a hypothesis about what has happened.

Explain

1. Students watch the US Environmental Protection Agency's Water Cycle demonstration at http://www.epa.gov/safewater/kids/flash/flash_watercycle.html
2. Teacher illustrates the water cycle on the white board.
3. Students complete the water cycle worksheet and paste it in their science notebooks, using the white board illustration as a model.
4. Teacher shows slide of salt processing plant at the Great Salt Lake and discusses how evaporation of salty water leaves salt residue. Refers to the salt works in *The Day the River Ran Away*.
5. The teacher shows a slide of tufa at the Salton Sea, and discusses how it was formed.

Extend

1. Why is the Coachella Valley a desert?
2. Teacher shows slide of the rain shadow effect and discusses.
6. Students draw the rain shadow effect in their science notebooks, using the slide as a model.

Evaluate

Informal evaluation of students' oral responses for evidence that students observe and know:

1. The heat of the sun causes water to evaporate.
2. Water can exist as water vapor, ice, or liquid water.
3. The stages of the water cycle.
4. The Coachella Valley is a rain shadow desert.
5. Water in the Salton Sea evaporates and leaves minerals such as salt behind.

Students' science journals show evidence that students can:

1. Make and record observations about the experiments they conduct.
2. Formulate a hypothesis.
3. Label the parts of the water cycle.
4. Draw the rain shadow effect.

APPENDIX K

THE DAY THE RIVER RAN AWAY LESSON FOUR

IV. Salton Sea: Whose Habitat is That?

California Standards and Environmental Principles

- A. E.E. Principle IV – The exchange of matter between natural systems and human societies affect the long-term functioning of both.
 - 1. Concept a - Students need to know that the effects of human activities on natural systems are directly related to the quantities of resources consumed and to the quantity and characteristics of the resulting byproducts.
 - 2. Concept b - Students need to know that the byproducts of human activity are not readily prevented from entering natural systems and may be beneficial, neutral, or detrimental in their effect.
 - 3. Concept c - Students need to know that the capacity of natural systems to adjust to human-caused alterations depends on the nature of the systems as well as the scope, scale, and duration of the activity and the nature of its byproducts
- B. Life Sciences Standard 3 – Adaptations in physical structure or behavior may improve an organism’s chance for survival.
 - 1. 3.b – Students know examples of diverse life forms in different environments, such as oceans, deserts, tundra, forests, grasslands, and wetlands.
 - 2. 3.d – Students know when the environment changes some plants and animals survive and reproduce; other die or move to new locations.

Objectives

- 1. Students will observe a demonstration of parts per thousands (ppt.)
- 2. Students will play a game that shows the succession of fish in the Salton Sea.

Materials and Setup

1. Book: *The Day the River Ran Away*
2. Cards for the game *Whose Habitat is That?*
3. Water, salt, and a clear plastic or glass container.

Background

When the Salton Sea was created, the only native fish in the California desert was the desert pupfish. In 1916, several species of freshwater fish had migrated from the Colorado River to the Salton Sea: carp, razorback sucker, rainbow trout, and striped mullet. The salinity of the sea in 1907 was 4 parts per thousand (ppt) of dissolved solids. In 1936, salinity had risen to 43 ppt. By 1942, only mullet and carp remained. The California Department of Fish and Game introduced 36 species of fish between 1929 and 1979, but few species were successful: orange mouth corvina, sargo, and croaker, all introduced from the Gulf of California, as well as tilapia which had been stocked in irrigation canals to control aquatic plant growth in the canals. The introduction of non-native species, as well as habitat loss, decimated the desert pupfish population, which was designated an endangered species in 1986. Current salinity is approximately 44 ppt. Potential loss of water to San Diego would further increase the salinity of the sea and threaten remaining species.

Timeframe

Demonstration and Game: Approximately 45 minutes

Extension Activities: Approximately 45 minutes

Engage

Read page 29 in *The Day the River Ran Away*

Adapted from Reaching Your Limits Project Wet, page 344.

1. Show a container with 100 ml of water mixed with red food coloring. Tell students this is a pollutant.
2. Mix 10 ml of the pollutant into 90 ml of clear water. Tell students this represents 1 part per 10 of pollutant.
3. Put 10 ml of this diluted solution and put it in 90 ml of water. This represents 1 part per 100.
4. Then put 10 ml of pollutant in 90 ml of clear water. This represents 1 part per 1,000.
5. This measurement is known as parts per thousand (ppt). Write "ppt = parts per thousand" on the white board.
6. Tell students that salt and pollutants in the Salton Sea are also measured in parts per thousand. In 1907, the ppt of salt and

other materials in the sea was 4 ppt. Write “1907 - ppt = 4” on white board.

Explore and Explain

1. If possible, this game should be done outdoors. Use chalk, string, or duct tape to section off a large area as the Salton Sea. If the game is conducted indoors, use painter’s tape to section off a part of the floor as the Salton Sea. Instructions are for a class of 30 students. Numbers may be adjusted as necessary.
2. Pass out yellow fish cards: 15 desert pupfish. Pass out orange fish cards: 3 razorback sucker, 3 rainbow trout, 2 striped mullet and 2 carp. Have ten additional orange cards available.
3. Explain that this game shows how fish have lived in the Salton Sea. This is a game of touch tag. All the fish must stay in the sea until they are tagged. Reserve 5 students to be red cards: salt and pollutants.
4. Begin with all the yellow pupfish in the sea. Explain that this represents the springs in the Salton Sink where fish lived. Pupfish live in natural springs in the desert. When the Salton Sea was created, some of these fish were swept into the sea.
5. Explain that the fish that lived in the Colorado River were fresh water fish. When the Colorado flooded the Salton Sink, fresh water fish entered the habitat of the pupfish. The pupfish could not compete with the bigger fish for food. In addition, the pupfish became food for some of the bigger fish.
6. Allow the orange fish to enter the sea. They can chase the pupfish. If a pupfish is tagged, he or she goes out, gets an orange card (moves up the food chain), and returns to the game.
7. When all the pupfish have been caught, explain that at the time of its creation in 1907, the Salton Sea had about 4 parts per thousand of salt, other minerals, and pollutants in its water. The freshwater fish could live in that water. Their numbers increased and caused the pupfish population to decline.
8. Explain that as time went by, the water in the Salton Sea evaporated. That meant that salts and other minerals entering the sea from the surrounding fields became more concentrated. The parts per thousand of salt increased to 43 ppt by 1936.
9. When all the pupfish have been caught, send in the five red salt and pollution cards. They can only tag orange cards. If an orange card gets tagged, he or she goes out.
10. When all the orange cards are gone, explain that the freshwater fish died because the water became too salty. The California Fish and Game Department brought in salt water fish from the

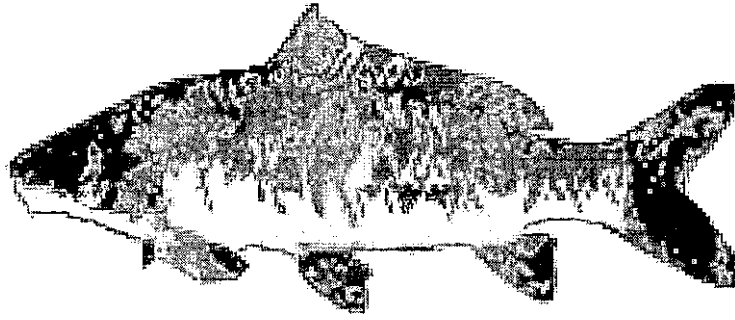
- Gulf of California. Pass out 20 purple cards: corvina, sargo, talapia, and croaker. Allow the fish to enter the sea.
11. Explain that in 2018, San Diego will take water out of the Salton Sea. Pass out 5 black cards. The black cards represent the water being pulled out of the sea. Allow the black cards to enter the sea and chase the purple cards.
 12. When all of the purple cards are gone, only red cards (salt and pollution) and black cards (no water) will remain. Ask: What will happen to the fish if water is removed from the Salton Sea? Ask: What will happen to the birds at the Salton Sea that eat the fish?

Extend

1. Students should refer back to *The Day the River Ran Away* pages 11 and 12 to make a chart of the kinds of plants, animals and birds that lived in the Salton Sink before the Salton Sea was created: for example, creosote bush, ocotillo, verbena, hawk, desert tortoise, jackrabbits, and coyote.
2. Then students could research the kinds of creatures that presently live near the Salton Sea, including desert creatures listed above, as well as creatures found at the marshy shoreline, such as ducks, Canadian geese, egrets, pelicans, terns, bitterns, etc.
3. Explain the concept of succession (one ecosystem being replaced by another.) Have the students chart the succession of plant and animal life at the Salton Sea from 1907 to the present.

Evaluate

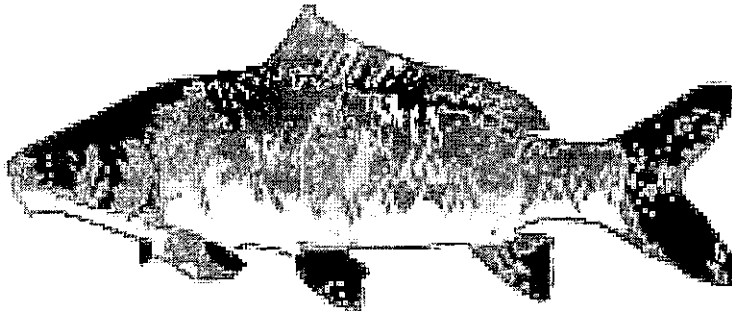
1. Informal- Do student comments during and after the game reveal that they understand that pupfish were replaced by freshwater fish from the Colorado River, and that in turn salt water fish replace the freshwater fish? Do students understand that too many parts per thousand of salt can cause creatures to die?
2. Does the chart display knowledge of succession from a desert to an aquatic environment?



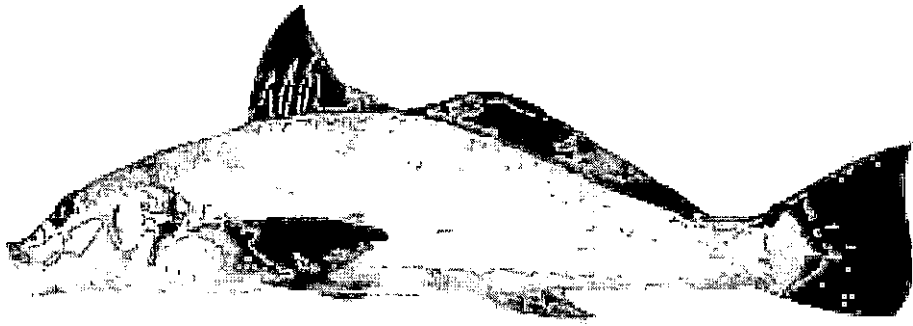
Carp



Carp



Carp



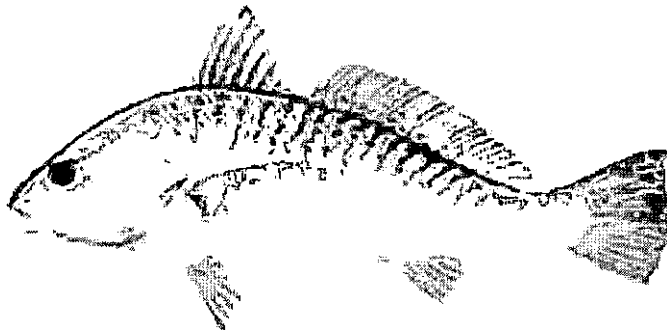
Corvina



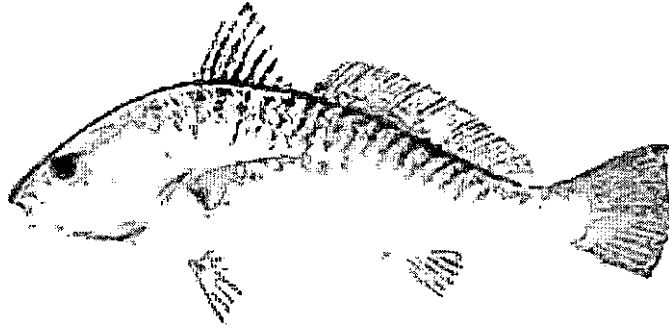
Corvina



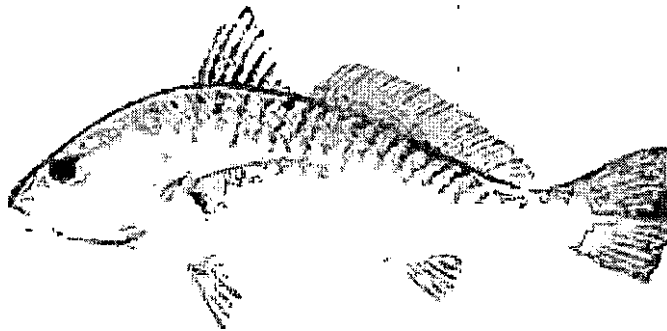
Corvina



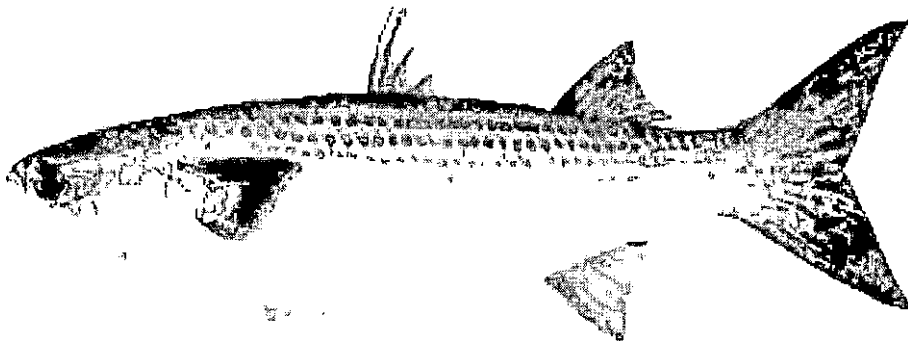
Croaker



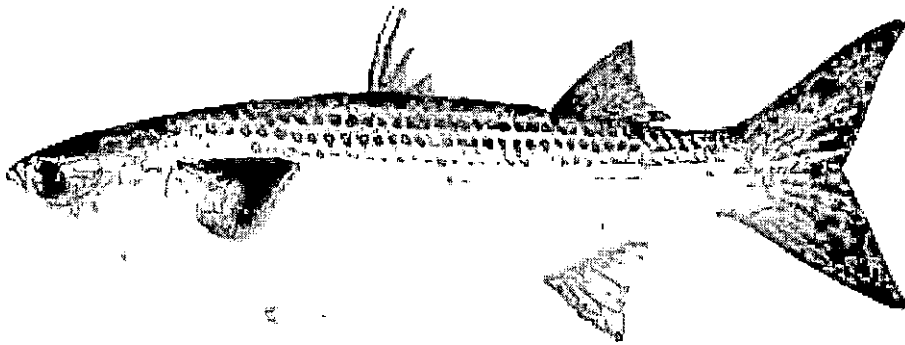
Croaker



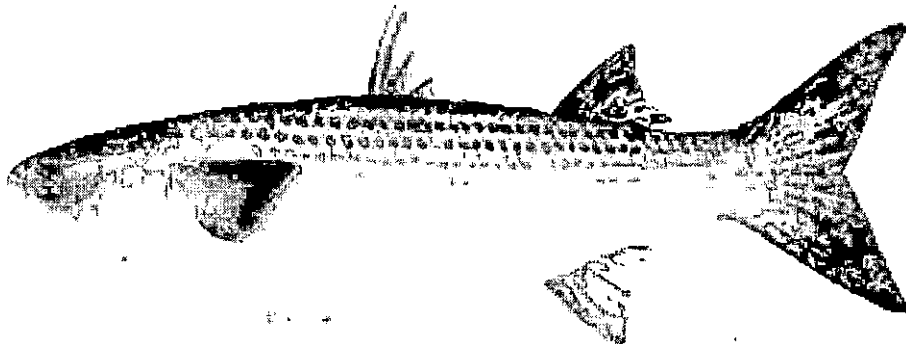
Croaker



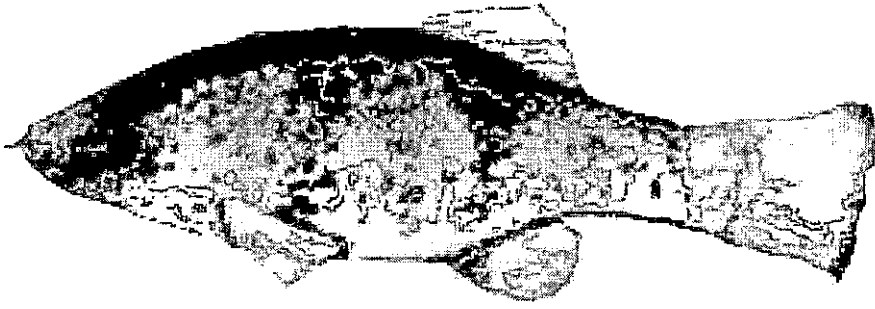
Striped Black Mullet



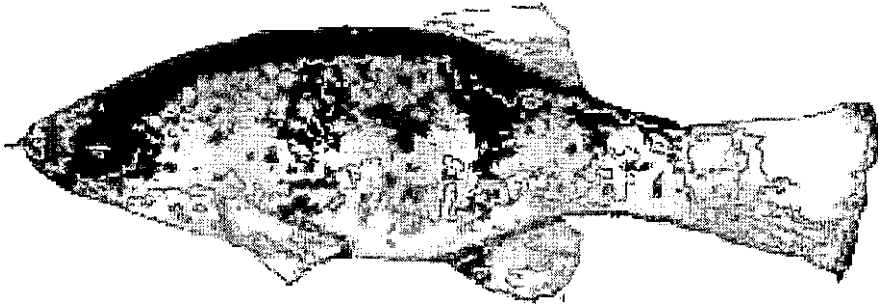
Striped Black Mullet



Striped Black Mullet



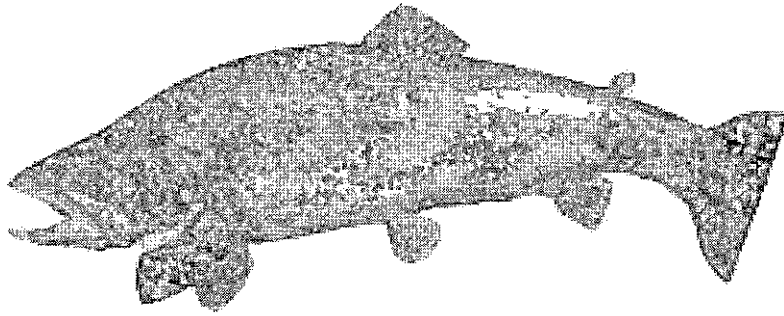
Desert Pupfish



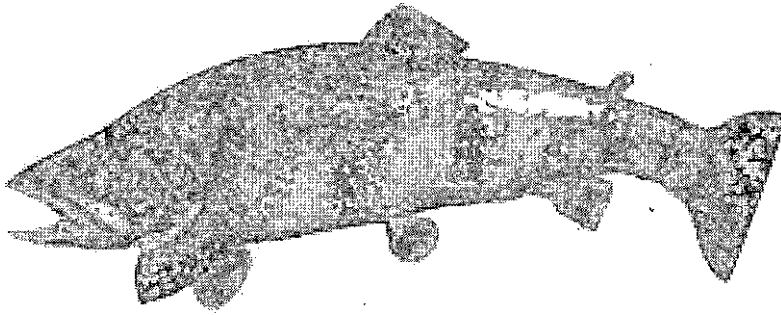
Desert Pupfish



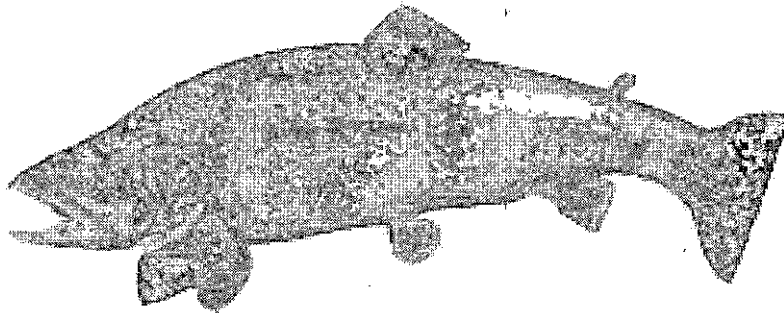
Desert Pupfish



Rainbow Trout



Rainbow Trout



Rainbow Trout



Razorback Sucker



Razorback Sucker



Razorback Sucker



Sargo



Sargo



Sargo



Talapia



Talapia



Talapia

APPENDIX L

THE DAY THE RIVER RAN AWAY LESSON FIVE

V. People and the Salton Sea: Yesterday, Today, and Tomorrow

California Standards and Environmental Principles

- A. E.E. Principle V - Decisions affecting resources and natural systems are based on a wide range of considerations and decision-making processes. As a basis for understanding this principle:
 - 1. Concept b - Students need to know the process of making decisions about resources and natural systems, and how the assessment of social, economic, political, and environmental factors has changed over time.
- B. Social Studies Standard 3.3.3 – Trace why the community was established, how individuals and families contributed to its founding and development, and how the community has changed over time, drawing on maps, photographs, oral histories, letters, newspapers, and other primary sources.

Objectives

- 1. Students will match explores and inhabitants of the Salton Sink with the appropriate era.
- 2. The students will make a timeline of the people of the Salton Sink: Native Americans, Spanish explorers and priests, Mormon Battalion soldiers, miners; salt miners, homesteaders, railroaders, vacationers, Slab City mobile home people, and current residents.

Materials and Setup

- 1. Book: *The Day the River Ran Away*
- 2. Picture cards of Salton Sink peoples mounted on small sheets of construction paper.
- 3. Tape or magnets.
- 4. Timeline drawn on large sheet of butcher paper, with room to place pictures on the following dates: 10,000 BCE (ancestral Cahuilla); 1540 (Melchior Diaz); 1774 (Don Juan Bautista de Anza); 1825 (Jedediah Smith); 1847 (Mormon Battalion); 1849 ('49ers gold miners); 1877 (Southern Pacific Railway); 1892 (Imperial Salt Company); 1901 (homesteader); 1944 (Paul Tibbets); 1946 (slab city); 1950 (sport fishers);
- 5. Props: "Primitive-looking" basket (10,000 BCE), "Spanish-looking" cross (1540); black shawl (1774); beaver "fur"

or top hat (1825); fake sword (1847); shiny “gold” rock (1849); railroad cap (1877); package of salt (1892); hoe (1901); toy airplane (1944); sunglasses (1946), fishing pole (1950), mirror (today).

Timeframe

Approximately 45 minutes.

Engage

1. Who were some of the people in the book *The Day the River Ran Away*? Charles Rockwood, pioneer developer; Gloria Torres, Cahuilla girl; Fig Tree John, Cahuilla man; Eps Randolph, hydrologic engineer; and E. H. Harriman, railroad owner. Those people were not the first people to come into the Salton Sink area.
2. Imagine that you were one of the first inhabitants of the Salton Sink, an ancestor of the Cahuilla people. You would live in a simple house made of brush. If you were a boy, you would learn to hunt for small animals. You might go fishing at fish traps along the shores of ancient Lake Cahuilla. If you were a girl you would learn to weave baskets and gather seeds. Imagine for a moment that you were one of the early Spanish explorers of the Salton Sink. You would have to cross the desert on foot. You would be anxious to find water and a place to camp at night. Imagine that you were a miner, alone except for a faithful burro. You would be looking for gold, toiling under the hot desert sun. All these people and many more have passed through the Salton Sink.

Explore/Explain

1. Pass out the pictures of the Salton Sea peoples.
2. Display the props.
3. Read the clues for each prop. Have the students decide which picture goes with which prop, then place the picture on the timeline.
4. Clues:
 - a. These people lived about 10,000 years before Christ. They lived in simple brush houses by the shores of ancient Lake Cahuilla. One of the ways they got food was to make fish traps out of rocks on the edge of the lake. You can still find these traps today by modern Lake Cahuilla. (Ancestral Cahuilla)

- b. This Spanish explorer led an expedition that came up the Colorado River from its mouth in the Gulf of California. The company crossed the desert in the Imperial Valley. The expedition took place only 11 years after the Pilgrims landed at Plymouth Rock. (Melchior Diaz)
- c. This colonizer brought the first Spanish families into Alta California. Over 300 people, including women and children, walked 1200 miles from New Spain to San Francisco, crossing the Salton Sink and the mountains in what is now Anza-Borrego State Park.
- d. This trapper was one of the first Americans to come to California. He came looking for beaver furs. He crossed the desert into San Diego, then went on to explore the Pacific Coast all the way to Oregon before returning to the Rocky Mountains. (Jedediah Smith)
- e. These men (and 3 women) made the longest Army infantry march in U.S. history, from Nebraska to San Diego. They crossed the Salton Sink pushing heavy wagons through the sand, and then carved a wagon road out of rocks in the mountains. You can still see the road at Box Canyon in Anza Borrego State Park. (Mormon Battalion)
- f. The men and women known as '49ers came to the California deserts in search of gold. They came from all around the world, from the eastern United States, from China, from Peru, and from Europe. Their one goal was to find gold and get rich. (The '49ers)
- g. These miners didn't mine gold. Instead, they mined the salt left behind when ancient Lake Cahuilla evaporated. (Salt miners)
- h. These men, women, and children left their homes in Europe or the Eastern United States to begin farms in the desert. These farms, or homesteads, depended on water brought in the canals of the Imperial Irrigation District. (Homesteaders)
- i. These people made a railroad across the desert to connect cities like San Diego and Los Angeles with the cities of the Eastern United States. People, merchandise, food, and supplies of all kinds traveled over the tracks built by these workers. (Workers on the Southern Pacific Railroad)
- j. In 1944, this man was the pilot of an airplane called the Enola Gay. During World War II, many soldiers prepared for war in the desert surrounding the sea. Many U.S. pilots

trained in the air above the Salton Sea. The Enola Gay and her crew practiced for an historic mission by dropping pretend bombs into the Salton Sea. However, the atomic bomb they dropped on Japan was not a pretend bomb. It caused great destruction in Hiroshima, but ended World War II. (Paul Tibbets)

- k. After World War II, the returning soldiers got married and had families. They liked to take their families to the Salton Sea to go camping, boating, waterskiing, and fishing. (Vacationers)
- l. These people live in trailers put on flat concrete areas called slabs. The slabs were left from a U.S. military training camp that was by the Salton Sea in World War II. The inhabitants of slab city don't own the slabs, but they pay little or no rent to live there. (Slab City mobile home)
- m. These people live in homes, go to work or school, and shop in Indio, Mecca, Coachella, or Brawley. Their life is like yours. (Current residents)

Extend

1. Students can work with their families at home to make a timeline of their own family history.

Evaluate

1. Informal – Are the students able to place the event on the timelines?
2. Do student personal timelines show evidence of specific events linked to specific dates, in other words, evidence of the passage of time?

APPENDIX M

THE DAY THE RIVER RAN AWAY LESSON SIX

VI. Review and Post-Assessment

Objectives

1. The students will review the Salton Sea unit by watching two PowerPoint presentations: a) The Salton Sea: Yesterday, and b) The Salton Sea: Today.
2. The students will review the Salton Sea unit by completing the KWL chart started in Lesson One.
3. The students will demonstrate their understanding of the Salton Sea by drawing a picture that shows everything they know about the Salton Sea.
4. The students will demonstrate factual knowledge about the Salton Sea by answering a multiple choice test about the Salton Sea.
5. The students will respond in writing to an attitude survey read by the teacher.

Materials and Setup

1. PowerPoint presentation and narrator script: The Salton Sea: Yesterday.
2. PowerPoint presentation and narrator script: The Salton Sea: Today.
3. Plain paper titled, "Draw a picture that shows everything you know about the Salton Sea."
4. Salton Sea multiple choice test.
5. Salton Sea attitude assessment survey.

Timeframe

PowerPoint presentations, rereading, and KWL chart: Approximately 45 minutes

Assessment: Approximately 45 minutes

Engage and Explain

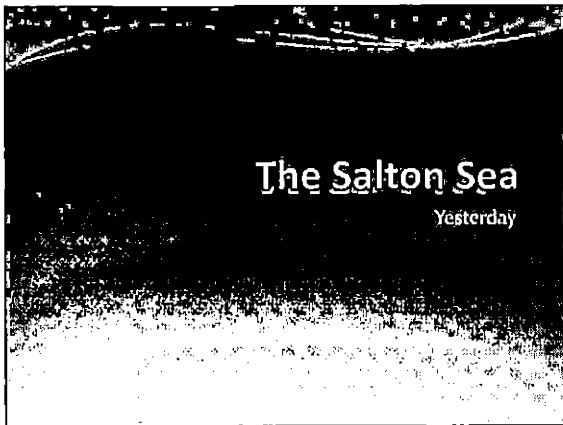
1. Reread *The Day the River Ran Away*.
2. Display the KWL chart. Go through the questions and review the answers presented by the unit.
3. Show the PowerPoint presentations and read the accompanying scripts.
4. Discuss and answer any questions.

Evaluate

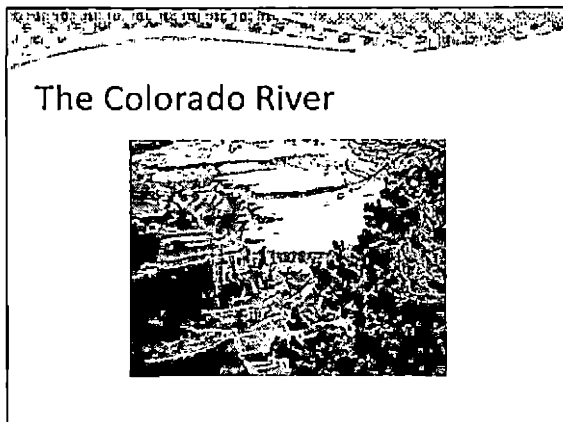
1. Read aloud the Salton Sea attitude survey while students answer it.
2. Read aloud the multiple choice tests while students answer it.
3. Have the students draw pictures showing everything they know about the Salton Sea.

APPENDIX N
POWERPOINT PRESENTATION: THE
SALTON SEA YESTERDAY

Slide 1

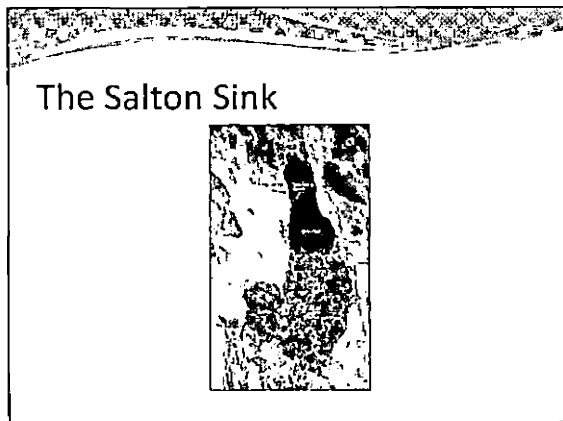


Slide 2



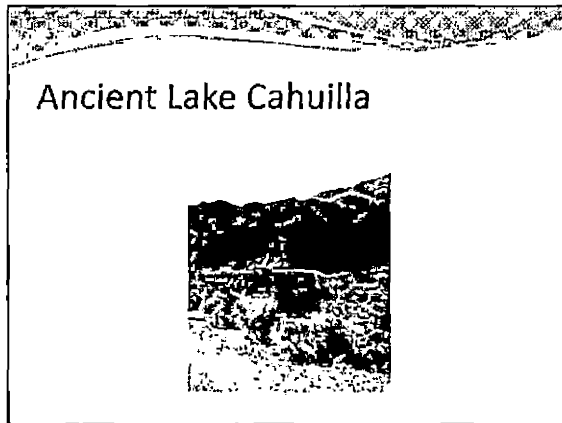
The Colorado River begins in the high Rocky Mountains of Wyoming and Utah. It passes through the Grand Canyon on its way to the Sea of Cortez, also called the Gulf of California.

Slide 3



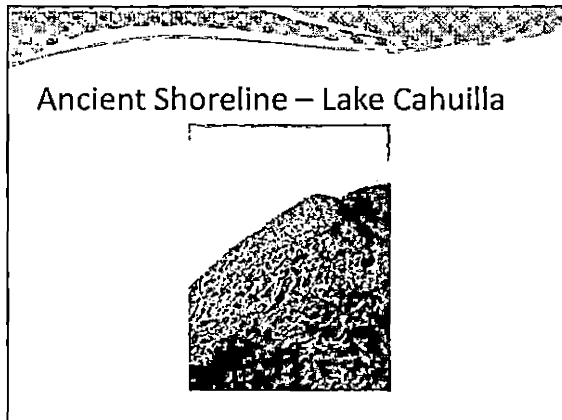
The Salton Sink is a very low place between the San Jacinto and Santa Rosa Mountains on the west, and the Chocolate Mountains to the east. Some parts of the Salton Sink are over 200 feet below sea level. The Coachella Valley to the north, and the Imperial Valley to the south are included in the Salton Sink.

Slide 4



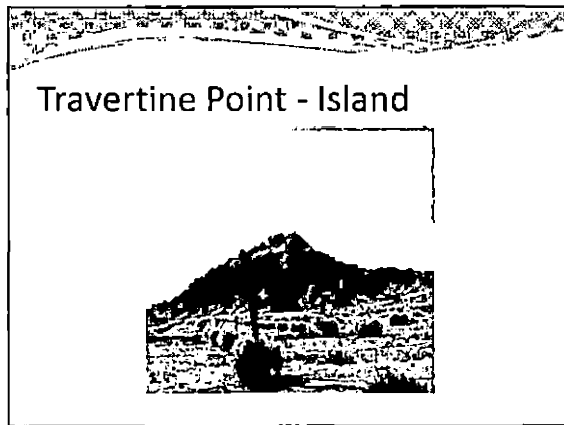
As long as 10,000 years ago, and as recently as 200 years ago, the Salton Sink was covered by a vast inland sea formed by the Colorado River. The Colorado River would deposit silt at its mouth, creating a river delta that would cause the water to run into the Salton Sink. Lakes would form, then the river would change course and the lakes dry up. Remnants of these ancient seas can be found in the small white sea shells found in desert sand. Along the side of these mountains near Thermal you can see where the beach of these ancient lakes used to be.

Slide 5



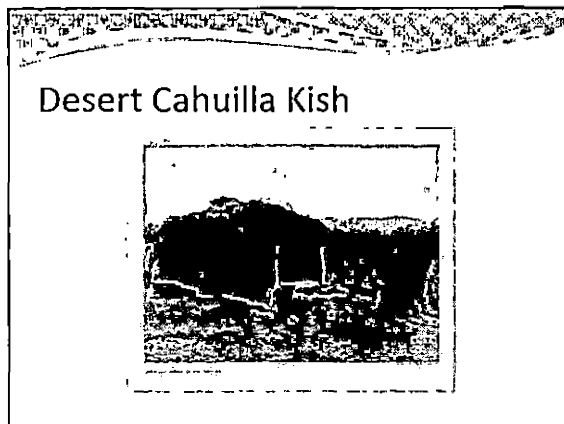
The white band on this mountain represents where the waves of the ancient seas used to lap against the rocks.

Slide 6



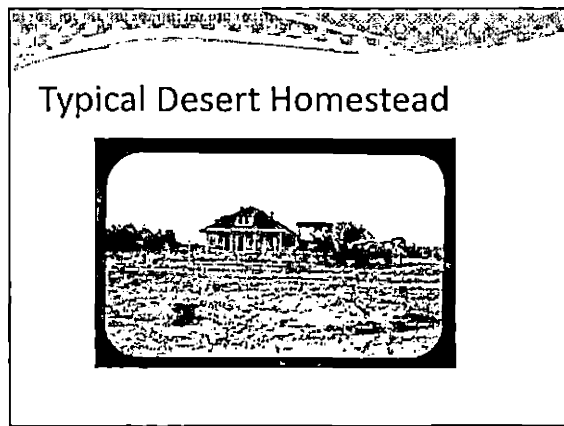
Travertine Point by Mecca used to be an island in Ancient Lake Cahuilla. You can see the white rocks that stuck up out of the water. The darker part was below the water line.

Slide 7



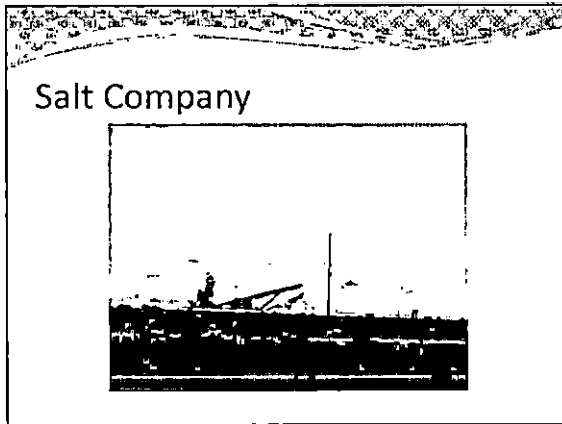
The ancestors of the Desert Cahuilla lived in small huts made of brush. These people lived along the shores of the lake and got food by trapping fish in rock fish traps.

Slide 8



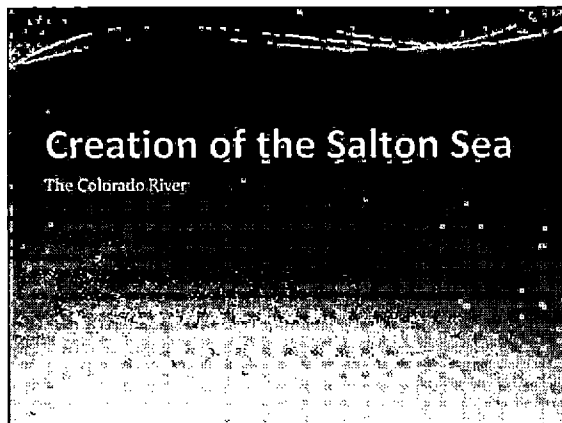
Early homesteaders depended upon water from wells to survive. Sometimes they used natural springs. Small fish called pupfish lived in those springs.

Slide 9



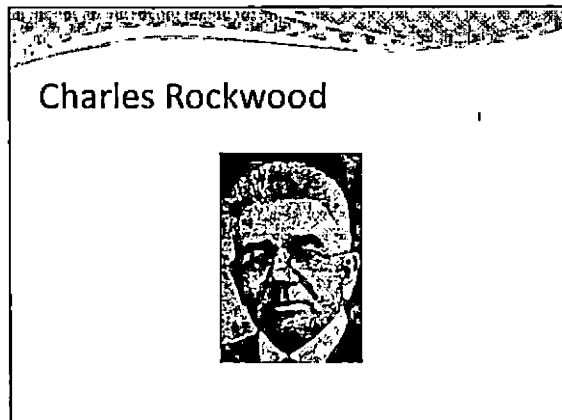
This modern day salt company near The Great Salt Lake in Utah shows how salt can be mined from dried lakebeds. At least two different salt companies operated on the floor of the Salton Sink.

Slide 10



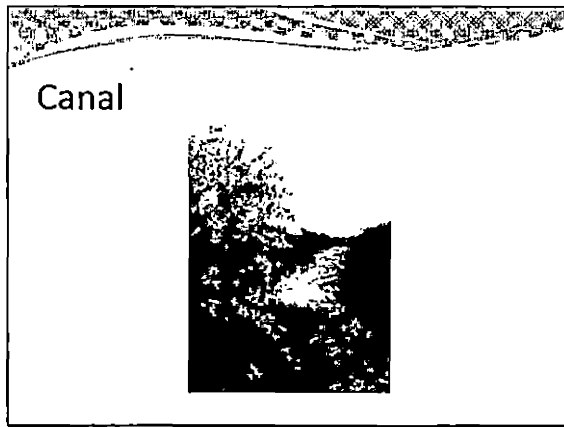
The Colorado River was responsible for the creation of the Salton Sea.

Slide 11



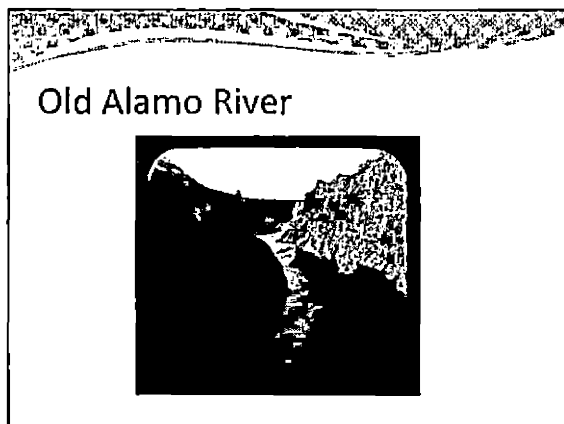
Charles Rockwood wanted to bring water from the Colorado River to the homesteaders of the Imperial Valley. He built a canal.

Slide 12



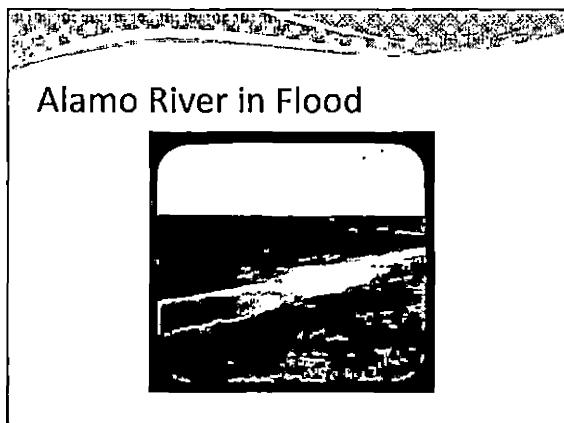
Canals still carry water to the fields of the Coachella and Imperial Valleys.

Slide 13



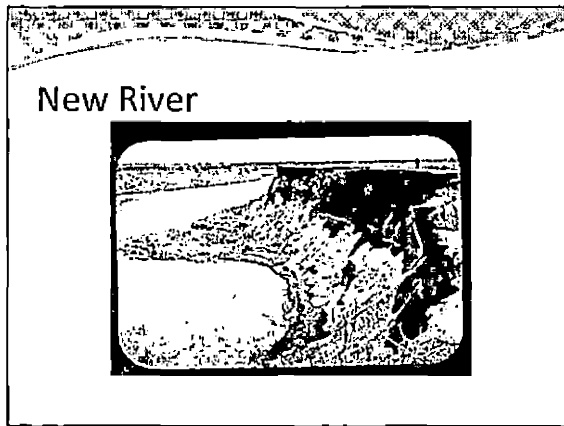
At first, the old Alamo River channel was used as part of the canal system to bring water to the farms of the Imperial Valley.

Slide 14



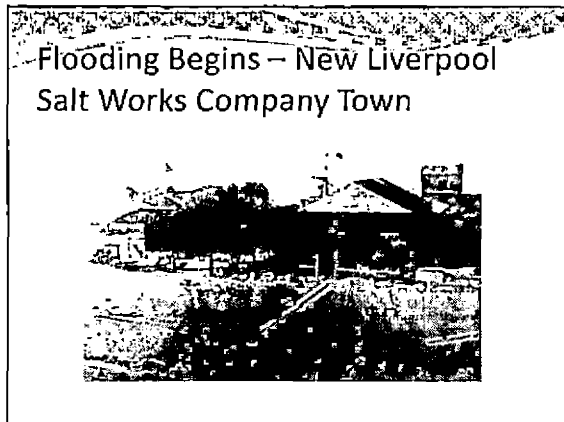
When the Colorado River ran away, the River cut away the banks of the Alamo River, making it much wider and flatter.

Slide 15



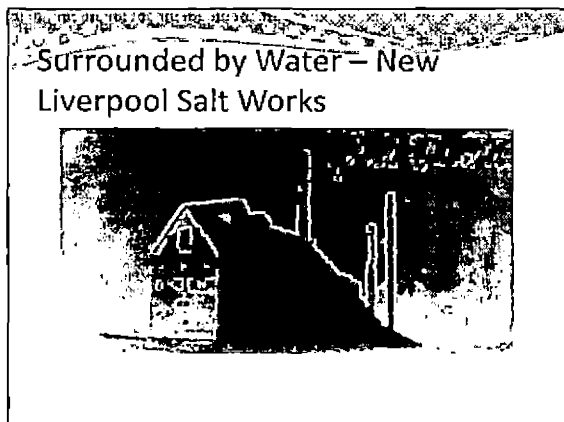
The River also ran away from the Alamo River channel. It cut out a brand new path across the desert, called the New River. The banks of the New River were deep.

Slide 16



The New Liverpool Salt Company had its own town. All the buildings were covered up by water, as were the railroad tracks.

Slide 17



Eventually all that remained visible were the smokestacks of the New Liverpool Salt Works. The rest of the buildings were covered up.

Slide 18

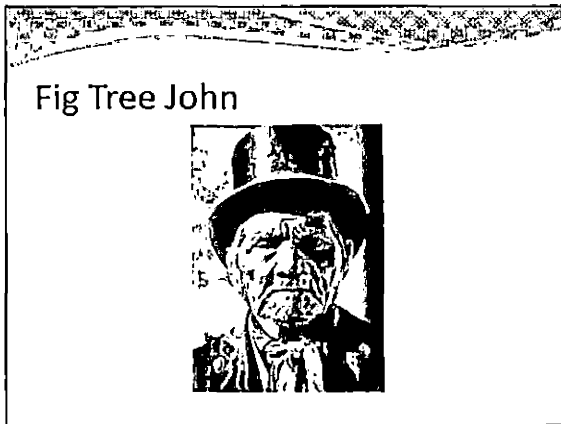
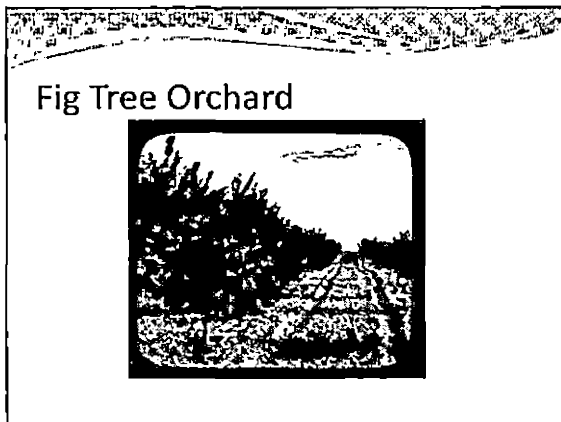


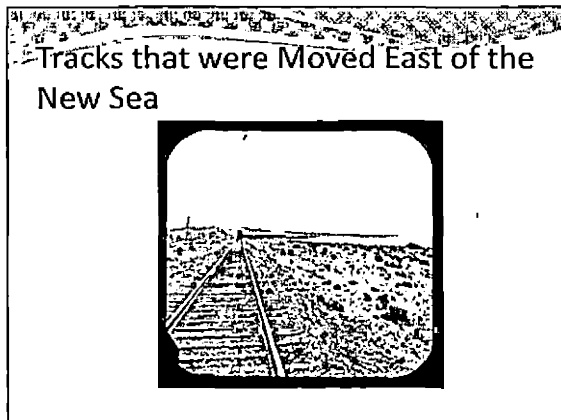
Fig Tree John was known for his kindness, his figs, and his stovepipe hat. His first orchard was completely flooded out by the Salton Sea.

Slide 19



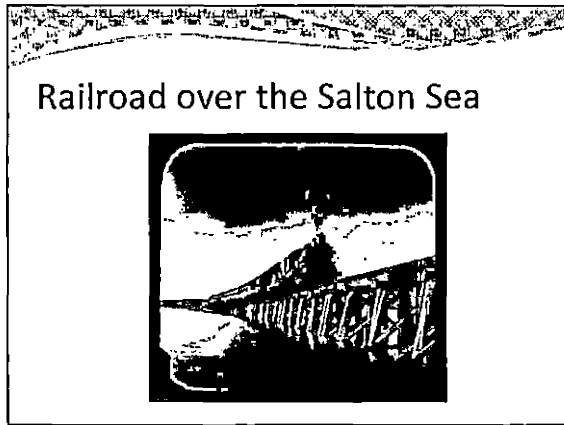
This is what a fig tree orchard in the desert looked like in Fig Tree John's time.

Slide 20



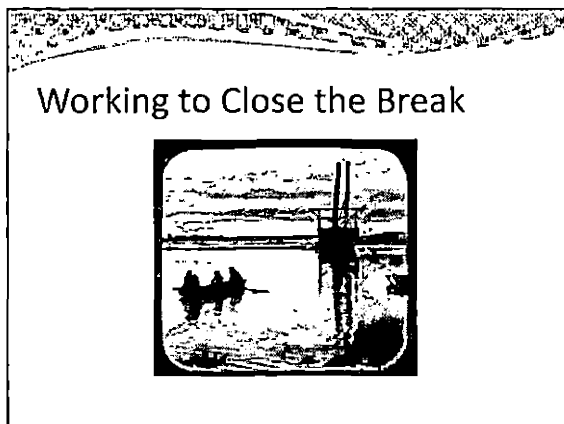
The tracks of the Southern Pacific Railroad were completely covered by the rising sea. They were relocated to higher ground on the east side of the Salton Sink.

Slide 21



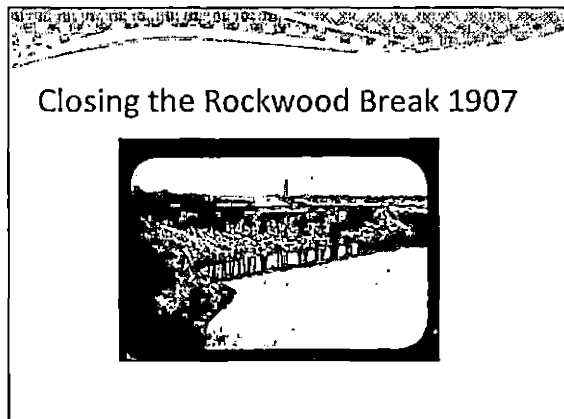
The tracks were also built onto a trestle raised above the level of the sea.

Slide 22



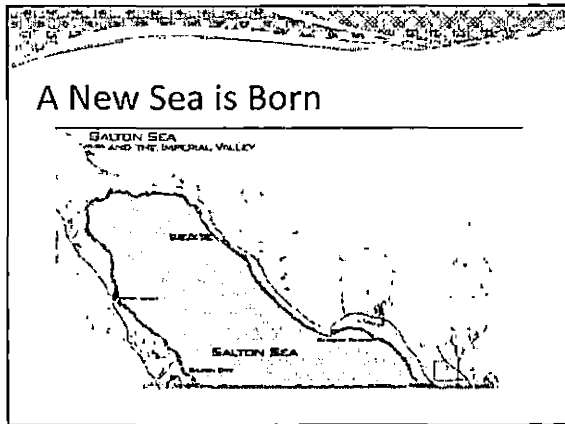
Workers tried to close the gap by putting stones on top of brush mats, but the Colorado River was too strong. At one time, there was a 100 foot waterfall where the river had cut back its bank.

Slide 23



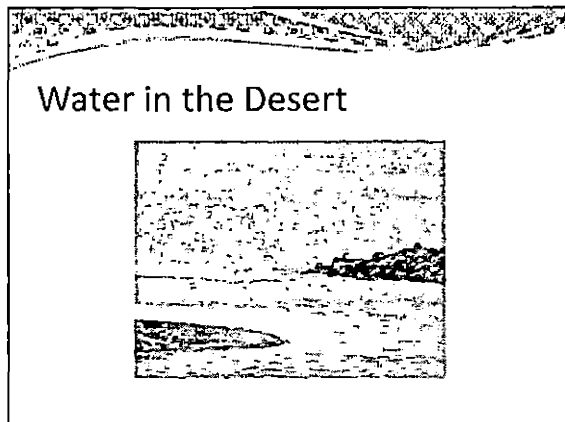
In 1907 the original break in the riverbank, called the Rockwood Break after Charles Rockwood, was finally closed when railroad cars dumped ton after ton of rocks into the gap.

Slide 24



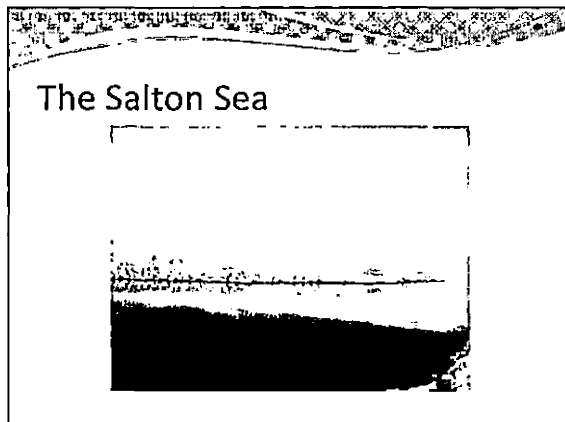
The new Salton Sea remained.

Slide 25



The Salton Sea remains as a wet habitat for fish and birds.

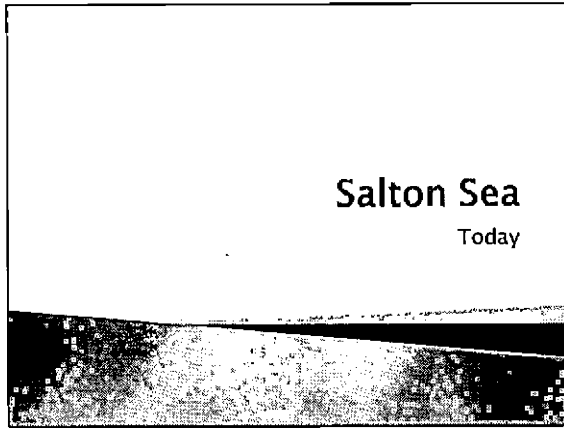
Slide 26



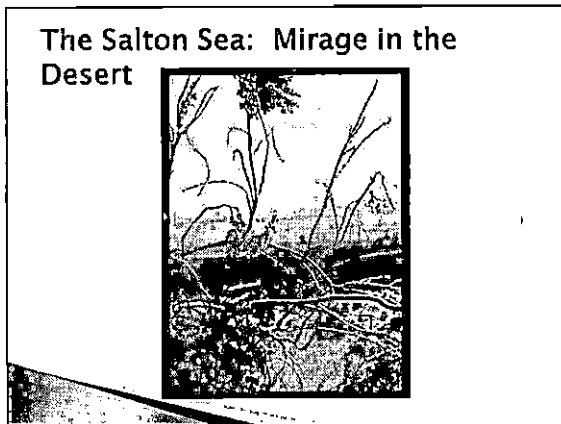
APPENDIX O

POWERPOINT PRESENTATION: THE SALTON SEA TODAY

Slide 1

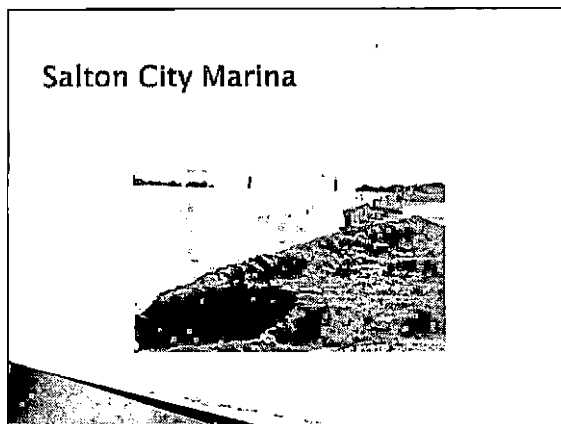


Slide 2



The Salton Sink is one of the hottest places in the United States. Summertime temperatures can rise over 120 degrees Fahrenheit.

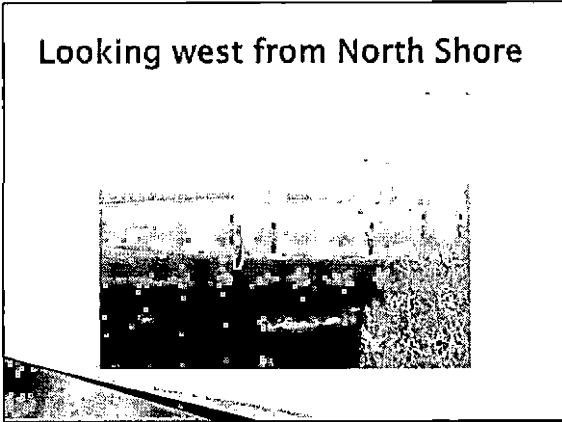
Slide 3



In the 1950's, thousands of recreational boats left from the marinas of the Salton Sea, filled with fishermen and water skiers. These stone walls remain from the days when many boats crossed these waters.

Slide 4

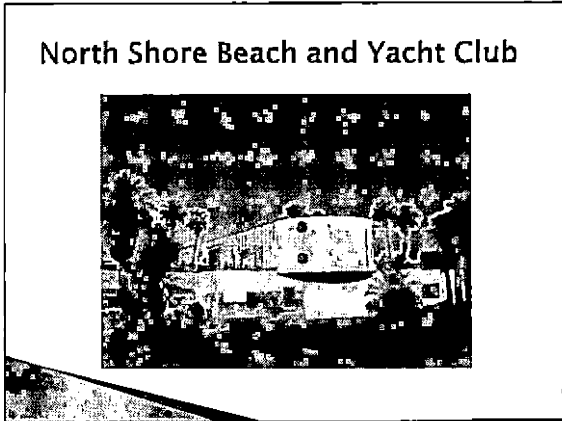
Looking west from North Shore



North Shore was a vacationer's paradise.

Slide 5

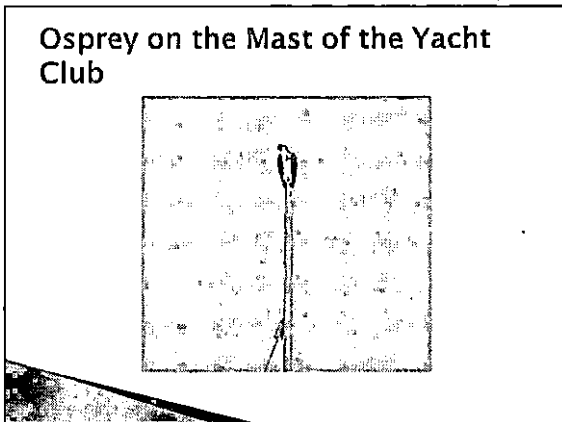
North Shore Beach and Yacht Club



The abandoned North Shore Beach and Yacht Club stands as a reminder of happier times at the Salton Sea.

Slide 6

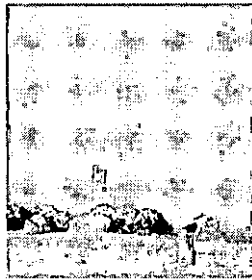
Osprey on the Mast of the Yacht Club



The osprey surveys the deserted marina. Ospreys are predators.

Slide 7

American White Pelican



The Salton Sea is a major stopover on the Pacific Flyway. More species of birds have been counted here than in the Florida Everglades.

Slide 8

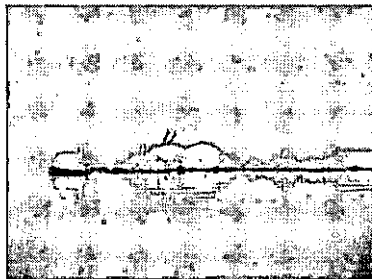
Refuge for Wildlife



The grasses of the Salton Sea area provide critical habitat for wildlife, especially water fowl.

Slide 9

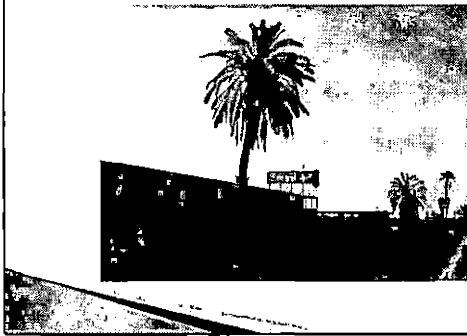
Egrets, Bitterns and Friends



The Salton Sea harbors a wide variety of birds.

Slide 10

Ghost Motel



Across from the Salton Sea Yacht Club, this motel reminds us of former glory.

Slide 11

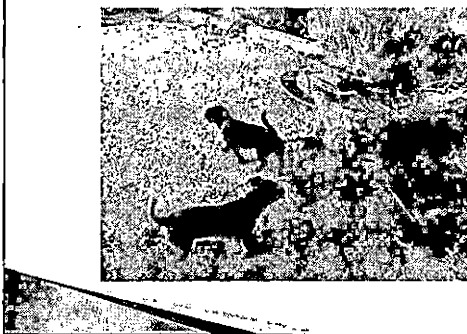
Marina



Another view of the marina at North Shore.

Slide 12

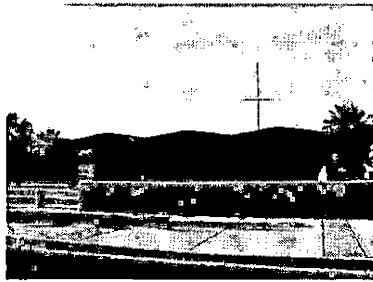
Local Inhabitants



These dogs were all too curious about the photographer.

Slide 13

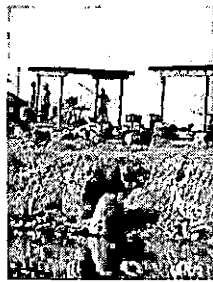
Salton Sea State Park



The Salton Sea State Park visitor center welcomes guests (mostly fishers and campers) to the Salton Sea.

Slide 14

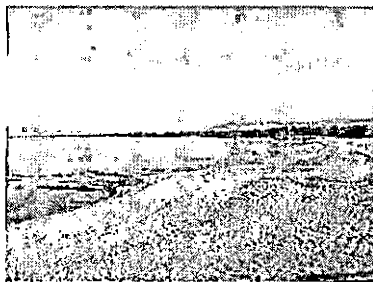
Preparing to Fish



People still fish at the Salton Sea.

Slide 15

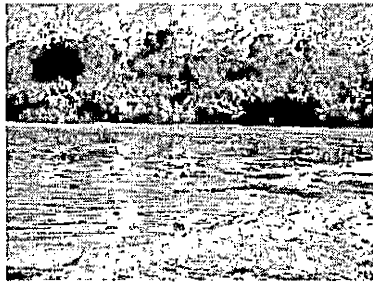
Tufa at State Park Beach



The beaches are made of tufa, a salty, tough material that is coarser than sand.

Slide 16

State Park Shoreline



The gulls and waterfowl don't seem to mind the tufa.

Slide 17

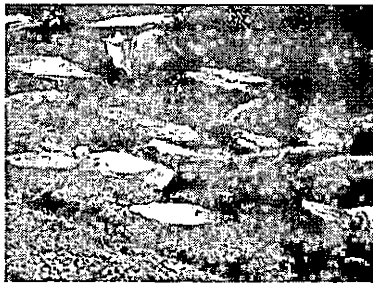
Fish Die Off



The fertilizers and other chemicals from farms around the sea provide a rich environment for algae to grow in the sea. Algae robs oxygen from the water, causing fish to die.

Slide 18

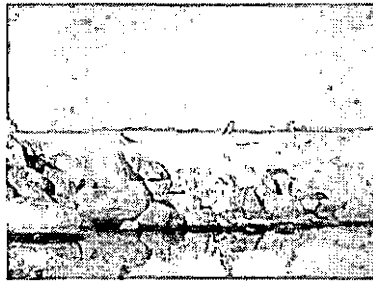
More Dead Fish



The massive fish die offs at the Salton Sea cause the sea to stink at times.

Slide 19

Black-necked Stilts



These are ocean birds, not desert birds, who survive here because of the water of the Salton Sea.

Slide 20

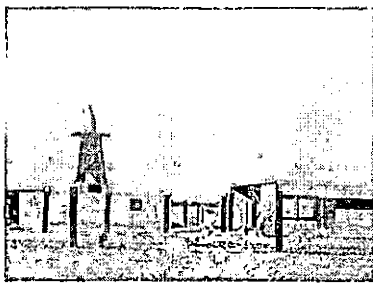
Salton Sea Marina



Looking west to the mountains of Anza-Borrego State Park.

Slide 21

Abandoned Homestead



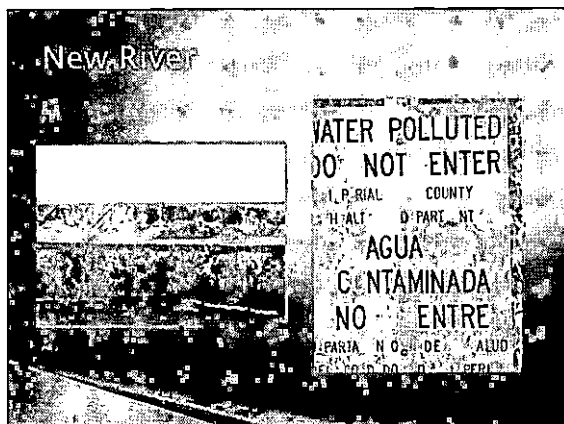
On the east shore of the Salton Sea, this abandoned homestead whispers of days of yore.

Slide 22



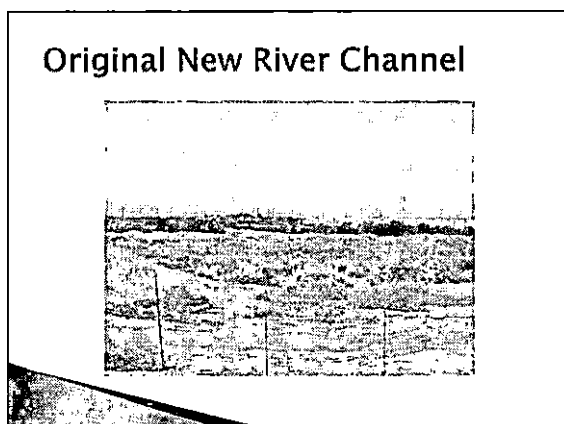
The Alamo River is polluted with fertilizers and other chemicals from the farms of Mexico and the Imperial Valley. It is dangerous to go in the contaminated water.

Slide 23



The New River was carved out when the Colorado burst its banks. The New River has been named the most polluted river in the entire United States.

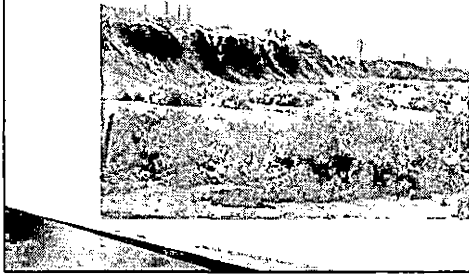
Slide 24



This wide area was once the riverbed of the Colorado River when it filled the Salton Sink.

Slide 25

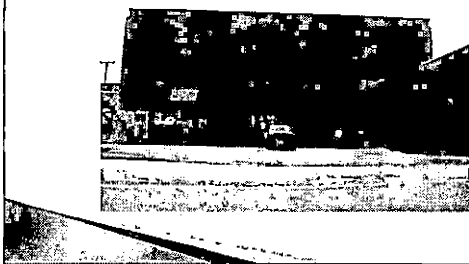
Old Riverbank



The depth of the Colorado's riverbank can be seen by comparing the banks with the telephone poles.

Slide 26

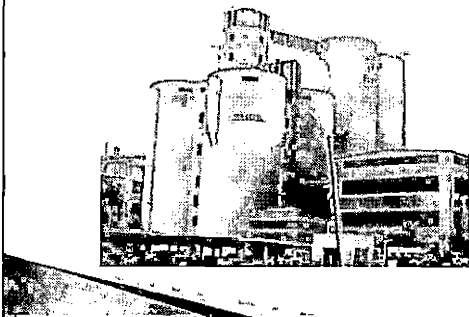
Old Imperial Development Company Ice Facility in Brawley



The Imperial Development Company was Charles Rockwood's company. This building remains from the old days.

Slide 27

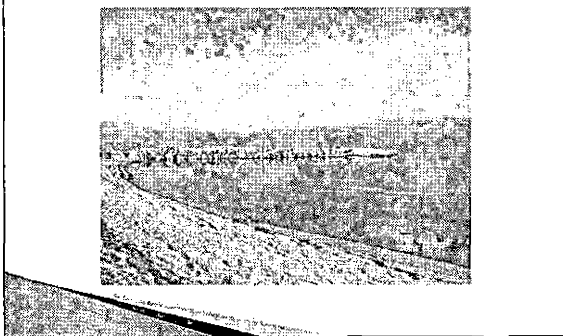
Sea Level Marking on Sugar Factory near Brawley



This sugar factory in Brawley shows the sea level mark on its building. The photographer is standing on the ground below sea level.

Slide 28

What will be the future of the Salton Sea?



The future is up to all of us.

REFERENCES

- Butzow, C., & Butzow, J. (1987). Science, technology, and society as experienced through children's literature. *Bulletin of Science Technology Society*, 7, 769-770.
- Christenson, M. (2004). Teaching multiple perspectives on environmental issues in elementary classrooms: A story of teacher inquiry. *Reports and Research*, 35(4), 3-16.
- Cohen, M. (2007, August). Salton Sea at a crossroads. *Geotimes*. Retrieved February 18, 2008, from http://geotimes.org/aug07/articlehtml?id-feature_saltonsea
- Cohen, M., & Hyun, K. (2006). *Hazard: The future of the Salton Sea with no restoration project*. Oakland, CA: The Pacific Institute.
- Cohen, M., Morrison, J., & Glenn, E. (1999). *Haven or hazard: The ecology and future of the Salton Sea*. Oakland, CA: Pacific Institute.

Cullen, G. (2005). The status of environmental education with respect to the goal of responsible citizenship behavior. In H. R. Hungerford, W. J. Bluhm, T. L. Volk, & J. M. Ramsey (Eds.), *Essential Readings in Environmental Education* (pp. 37-46). Champaign, IL: Stipes Publishing Company.

Department of Health & Human Services Agency for Toxic Substances & Disease Registry. (2003). *ToxFAQs for Selenium*. Washington, DC. Retrieved May 8, 2008, from Department of Health and Human Services Agency for Toxic Substances & Disease Registry Web site: <http://www.atsdr.cdc.gov/tfacts92.html>

Dresang, E. (2003). Controversial books and contemporary children. *Journal of Children's Literature*, 29(1), 20-31.

Environmental Protection Agency. *Thirstin's water cycle*. Retrieved June 25, 2008, from http://www.epa.gov/safewater/kids/flash/flash_watercycle.html

Howard, K., Stock, G., Rockwell, T., Schafer, J., & Webb, R. (2007). Holocene cyclical switching of Colorado River water alternatively to the Sea of Cortez or to the Salton Sink, *EOS Trans. AGU*, 88(23) Assem. Suppl., Abstract H44A-05.

Hungerford, H., Peyton, R. & Wilke, R. (1980). Goals for curriculum development in environmental education.

Journal of Environmental Education, 11(3), 42-47.

Hungerford, H., & Volk, T. (1991, May). *Curriculum development in environmental education for the primary school: Challenges and responsibilities.*

Invited Paper presented at the International Training Seminar on Curriculum Development in Environmental Education for the Primary School, Valletta, Malta.

Laflin, P. (1995). The Salton Sea: California's overlooked treasure. *The Periscope*. Indio, CA: Coachella Valley Historical Society.

Lieberman, G. (1997). *The EIC model*. Poway, CA: Science Wizards. Retrieved May 11, 2008, from <http://www.seer.org/pages/eic.html>

Lieberman, G., & Hoody, L. (1998). *Closing the achievement gap: Using the environment as an integrating context for learning*. Poway, CA: Science Wizards.

- MacDougal, D. (1914). *The Salton Sea: A study of the geography, the geology, the floristics, and the ecology of a desert basin* (Publication No. 193, pp. 280-284). Washington, DC: Carnegie Institution.
- Meyer, J. (2002). Accuracy and bias in children's environmental literature: A look at Lynn Cherry's books. *The Social Studies*, 227-281.
- Oglesby, L. (2005). The Salton Sea: Geology, history, potential problems, politics, and possible futures of an unnatural desert salt lake. *Memoirs of the Southern California Academy of Sciences*.
- Patten, M., McCaskie, G., & Unitt, P. (2003). *Birds of the Salton Sea*. Berkeley, CA: University of California Press.
- Project Wild aquatic*. (2005). Houston, TX: Council for Environmental Education.
- Salton Sea Authority, (2006). *Salton Sea restoration project*. U.S. Department of the Interior, Bureau of Reclamation. Retrieved April 20, 2008, from <http://www.salttonsea.ca.gov/>
- Sobel, D. (2004). *Place-based education* (2nd ed.). Great Barrington, MA: The Orion Society.

Stapp, W., et al. (1969). The concept of environmental education. *The Journal of Environmental Education*, 1(1), 30-31.

The Accessibility Institute. (2008). *Tx readability: A multi-language readability tool*. Austin, TX: The University of Texas at Austin. Retrieved October 15, 2008, from The Accessibility Institute Web site: http://www.utexas.edu/disability/ai/resource/manual/flesch_calculateEnglish.html

The Salton Sea Database Program. *Salton Sea: California's Everglades*. Redlands, CA: The Redlands Institute. Retrieved April 20, 2008, from http://www.institute.redlands.edu/salton/Downloads/Docs/SSBooklet_final.pdf

Tostrud, M. (1997). *The Salton Sea: Computed and measured salinities and water levels*. Colorado River Board of California.

Wardlaw, G., & Valentine, D. (2005). Evidence for salt diffusion from sediments contributing to increasing salinity in the Salton Sea, California. *Hydrobiologia*, 533, 77-86.

Wells, R., & Zeece, P. (2007). My place in my world:
Literature for place-based environmental education.
Early Childhood Education Journal, 35(3), 285-291.

Wolk, S. Teaching for critical literacy in social
studies. *The Social Studies*, 101-106.